DONATIONS TO THE BUILDING FUND

OF THE

ROYAL SOCIETY OF NEW SOUTH WALES.

From 11th September, 1877, to 31st December, 1886.

	£	s.	d.
Abbott, Hon. J. P., M.L.A. (£1 1s., £5 5s.)	6	6	0
Abbott, Thos. K., S.M.	3	0	0
Abbott, W. E. (£1 1s., £10)	11	1	0
Alexander, G. M.	1	1	0
Amos, Robert	10	10	0
Baas, J. R.	1	1	0
Bartels, W. C. W.	5	0	0
Bassett, W. F., M.R.C.S.E.	1	1	0
Belfield, A. H.	3	3	0
Bennett, G. F., C.M.Z.S.	1	0	0
Bensusan, S. L.	2	2	0
Berney, Augustus	1	18	0
Blackmann, C. H. E.	3	3	0
Bladen, Thomas	2	2	0
Bolding, H. J. (£5, £2 2s.)	7	2	0
Bowen, G. M. C.	2	2	0
Bradridge, T. H.	2	2	0
Brazier, John, C.M.Z.S. (£3 3s., £2 2s.)	5	5	0
Brindley, Thomas	1	1	0
Brodribb, Hon. W. A., M.L.C., F.R.G.S. (£10 10s., £2)	12	10	0
Brooks, Joseph, F.R.G.S.	2	2	0
Brown, H. J. (£1 1s., £1 1s.)	2	2	0
Brown, Thomas	5	0	0
Brown, David	2	2	0
Burnell, A. J. (£2 2s., £2 2s.)	4	4	0
Cadell, The Hon. Thomas, M.L.C.	1	1	0
Cadell, Alfred	1	1	0
Caird, George S.	5	5	0
Cameron, John	2	2	0
Campbell, Hon. Alex., M.L.C.	20	0	0
Campbell, Allan, L.R.C.P. (£5 5s., £5, £2 2s.)	12	7	0
Campbell, Rev. Joseph, M.A., F.G.S.	1	1	0
Chard, J. S. (£2 2s., £1 1s.)	3	3	0
Chisholm, Edwin, M.R.S.C.E.	5	0	0
Chisholm, William, M.D., London	2	2	0
Christie, W.	5	5	0
Clarke, Rev. W. B., M.A., F.R.S.	5	5	0
Codrington, J. F., M.R.C.S., L.R.C.P., Lon. (£1 1s., £2 2s.)	3	3	0
Collie, Rev. Robert, F.L.S.	2	2	0
Colyer, J. U. C.	2	2	0
Comrie, James	2	2	0
Conder, W. J. (£5 5s., £5)	10	5	0
Conlan, G. N., F.R.G.S.	2	2	0
Cox, Hon. G. H., M.L.C. (£5 5s., £20)	25	5	0
Croudace, Thomas	3	0	0
Daintrey, E. (£5 5s., £5 5s.)	10	10	0
Dangar, F. H.	50	0	0
Darley, C. W.	3	3	0

	£	s.	d.
Dean, Alex., J.P. (£1 1s., £10)	11	1	0
Delarue, L. H.	2	2	0
De Salis, Hon. L. F., M.L.C. (£10, £3 19s.)	13	19	0
De Salis, L. W., junr. (£10, £1 1s.)	11	1	0
Dight, Arthur	5	5	0
Dixon, W. A., F.C.S. (£3 3s., 21s., 21s., 21s., 21s., 21s., 21s.)	9	9	0
Dixson, Craig, M.D., Syd.	1	1	0
Dixson, Thos., M.B., C.M., Ed.	1	1	0
Docker, E. B.	3	3	0
Du Faur, E., F.R.G.S. (£1 1s., £3 3s.)	4	4	0
Evans, George (£3 3s., £5)	8	3	0
Ewan, J. Fraser, M.B., Mast. Surg., Edin.	5	5	0
Fairfax, E. R. (£10 10s., £200)	210	10	0
Fairfax, James R.	20	0	0
Flavelle, Bros. and Roberts (£5, £2 2s.)	7	2	0
Flavelle, John	5	0	0
Fraser, Robert	2	2	0
Frazer, Hon. John, M.L.C.	20	0	0
Gilliat, H. A.	1	1	0
Goodlet, John H.	10	0	0
Grahame, Hon. W., M.L.C.	5	0	0
Griffiths, F. C. (£10 10s., £5 5s., £5)	20	15	0
Gurney, Professor, M.A.	10	0	0
Haege, Hermann (£5 5s., £3 3s.)	8	8	0
Hall, R. T., (21s., 21s., 21s.)	3	3	0
Hargrave, Lawrence	5	0	0
Harrison, L. M. (£10 10s., £10)	20	10	0
Haswell, W. A., M.A., B.Sc.	1	1	0
Hay, Hon. Sir John, K.C.M.G. (£20, £1)	21	0	0
Helms, Albert, Ph. D., Berlin	2	2	0
Henry, James	3	3	0
Heron, Henry (£10 10s., £5, £2 2s.)	17	12	0
Hills, Robert	5	0	0
Hirst, G. D. (21s., 21s., 21s., 21s., 21s.)	5	5	0
Hitchins, E. L.	3	3	0
Holmes, Spencer H.	1	1	0
Holt, Hon. Thomas, M.L.C.	10	0	0
Horton, Rev. Thomas	2	0	0
Hume, F. R.	5	5	0
Hume, J. K. (£3 3s., £2 2s.)	5	5	0
Hunt, Robert, F.G.S. (£5 5s., £2 2s., 21s., 21s., 21s., 21s., 21s.)	12	12	0
Inglis, The Hon. James, M.L.A. (21s., 21s.)	2	2	0
Jackson, H. W., M.R.C.S.E., L.R.C.P., Edin.	1	1	0
Johnson, J. W.	2	2	0
Jones, James	2	2	0
Jones, J. A., L.R.C.P., Edin.	1	1	0
Jones, P. Sydney, M.D.	10	10	0
Josephson, J. F., F.G.S.	20	0	0
Josephson, J. P., A.M.I.C.E. (£3 3s., £2 2s.)	5	5	0
Kater, H. C.	10	0	0
Keele, T. W.	3	3	0
Keep, J.	5	5	0
Kinloch, J., M.A.	2	2	0
Knibbs, G. H.	4	4	0
Knox, Hon. Edward, M.L.C. (£20, £10)	30	0	0
Knox, E. W. (£2 2s., £2 18s.)	5	0	0
Latta, G. J. (£1 1s., £3 3s.)	4	4	0
Leibius, A., Ph. D., M.A. (£5 5s., £2 2s., £1 1s., £5)	13	8	0
Lenehan, H. A. (£2 2s., £2 2s.)	4	4	0

	£	s.	d.
Liversidge, Prof., F.R.S. (£10, 21s., 21s., £3 3s., 21s., 21s., £5 5s.)	22	12	0
Lowe, Edwin	3	3	0
Lowe, Hamilton	1	1	0
MacDonald, E. (£2 2s., £2 2s.)	4	4	0
MacDonnell, S.	1	1	0
MacDonnell, W. (£5, £2 2s.)	7	2	0
Mackenzie, John, F.G.S.	5	0	0
MacPherson, Rev. P., M.A. (£2 2s., £2 2s.)	4	4	0
Maitland, D. M.	1	1	0
Makin, G. E. (£1 1s., £2 2s.)	3	3	0
Manfred, E. C.	1	1	0
Mann, J. F.	3	3	0
Manning, F. N., M.D., St. And. (£5 5s., £2 2s.)	7	7	0
Manning, Sir Wm., LL.D. (£2 2s., £7 18s.)	10	0	0
Matthews, Robert C. (£1 1s., £1 1s.)	2	2	0
Markey, James, L.R.C.P., Edin.	1	1	0
Marsden, Right Rev. Dr.	1	1	0
Martin, Rev. G	2	2	0
Merriman, J.	5	5	0
Moir, James	3	3	0
Moore, Charles, F.L.S. (£5, £2 2s.)	7	2	0
Morehead, R. A. A. (£10, £5)	15	0	0
Morley, F.	2	2	0
Mullens, Josiah, F.R.G.S. (£10, £10)	20	0	0
Mullins, J. F. L., M.A.	3	3	0
Murnin, M. E.	2	2	0
Murray, W. G. (£5, £1 1s., £10)	16	1	0
Myles, C. H.	2	2	0
Norton, Hon. James, M.L.C.	5	0	0
O'Reilly, Rev. A. Innes, B.A.	1	1	0
O'Reilly, W. W. J., M.D., Queen's Univ., Irel.	1	1	0
Palmer, E., M.L.A., Q'land	1	1	0
Parrot, Major T. S.	1	1	0
Paterson, H.	2	2	0
Pedley, P. R.	5	5	0
Pittman, E. F.	1	1	0
Poolman, F.	5	5	0
Porter, Donald	2	2	0
Potts, F. H.	2	2	0
Quaife, F. H., M.D., Mast. Surg., Glas.	3	3	0
Quirk, Rev. D. Placid, M.A.	1	1	0
Quodling, W. H. (21s., 21s.)	2	2	0
Reading, E.	2	2	0
Riddell, C. E.	1	1	0
Roberts, John	5	0	0
Roberts, C. J., C.M.G., M.L.A.	2	2	0
Robertson, Thomas	2	2	0
Rolleston, Christopher, C.M.G. (£10, £5)	15	0	0
Rothe, W. H.	2	2	0
Russell, H. C., B.A., F.R.S. (£10, £3 3s., 21s., 21s., 21s., 21s., 21s.)	18	8	0
Sandy, James	2	2	0
Scott, Rev. W., M.A.	5	0	0
Selfe, Norman, M.I.C.E.	10	10	0
Sharp, J. B., J.P. (£5 5s., £5 5s.)	10	10	0
Sharp, Henry	3	3	0
Shelshear, Walter, A.M.I.C.E.	1	1	0
Shepherd, T. W.	1	1	0
Sleep, John S.	1	1	0

	£	s.	d.
Smith, Hon. Professor, C.M.G., M.L.C. (£5, £2 2s., £1 1s.)	8	3	0
Smith, Robert, M.A.	10	10	0
Starkey, J. T.	2	0	0
Stephens, Prof. W. J., M.A.	2	2	0
Styles, G. M.	2	2	0
Suttor, W. H.	7	10	0
Syer, F. W.	1	1	0
Taylor, W.	1	0	0
Tebbutt, J., F.R.A.S.	10	0	0
Thomas, H. A. (£3, £2 2s.)	5	2	0
Thomson, Joseph	5	0	0
Thomson, Dugald	2	2	0
Thompson, J. Ashburton, M.D. (Brux.)	2	2	0
Toohey, J. T.	10	0	0
Trouton, F. H. (£3 3s., £1 1s.)	4	4	0
Tucker, G. A., Ph. D.	10	10	0
Voss, H. H., J.P. (£10 10s., £20)	30	10	0
Walker, Thomas	500	0	0
Walker, H. O.	1	1	0
Ward, Major-General Sir Edward, K.C.M.G., R.E.	5	0	0
Ward, J. W. (£2 10s., £2 10s., £2 2s., £2 2s., £2 2s.)	11	6	0
Ward, R. D., M.R.C.S.	5	5	0
Wardell, W. W., M.I.C.E.	3	3	0
Waterhouse, J.	2	2	0
Watt, A. J. (£5 5s., £1 1s.)	6	6	0
Watt, Charles	2	2	0
Webster, A. S. (£10, £10)	20	0	0
Welsh, E. W.	1	1	0
Westgarth, G. C.	2	2	0
Weston, W. J. (£2 2s., £5)	7	2	0
White, Rev. Dr. J. S., M.A.	1	1	0
Wiesener, T. F.	1	1	0
Wilkinson, C. S., F.G.S. (£5 5s., £2 2s., £2 2s.)	9	9	0
Wilshire, J. T.	1	1	0
Woolrych, F. B. W. (£3 3s., £2 2s., £1 1s.)	6	6	0
Wright, H. G. A., M.R.C.S.E. (£5 5s., 21s., 21s., 21s., 21s., 21s., 21s., 21s.)	12	12	0
Young, L. H. G.	1	1	0
	£1,904	12	0

ROYAL SOCIETY OF NEW SOUTH WALES.

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JOURNAL

AND

PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

NEW SOUTH WALES,

FOR

1886.

INCORPORATED 1881.

VOL. XX.

EDITED BY

A. LIVERSIDGE, F.R.S.,

Professor of Chemistry and Mineralogy in the University of Sydney.

THE AUTHORS OF PAPERS ARE ALONE RESPONSIBLE FOR THE STATEMENTS MADE AND THE OPINIONS EXPRESSED THEREIN.

AGENTS FOR THE SOCIETY:

Messrs. Trübner & Co., 57, Ludgate Hill, London, E.C.

SYDNEY: CHARLES POTTER, GOVERNMENT PRINTER.

1887.

Mo. Bot. Garden

1897.

NOTICE.

THE ROYAL SOCIETY of New South Wales originated in 1821 as the "Philosophical Society of Australasia"; after an interval of inactivity, it was resuscitated in 1850, under the name of the "Australian Philosophical Society," by which title it was known until 1856, when the name was changed to the "Philosophical Society of New South Wales"; in 1866, by the sanction of Her Most Gracious Majesty the Queen, it assumed its present title, and was incorporated by Act of the Parliament of New South Wales in 1881.

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ASSISTANT SECRETARY:

W. H. WEBB.

ROYAL SOCIETY OF NEW SOUTH WALES.

ACT OF INCORPORATION.

An Act to incorporate a Society called "The Royal Society of New South Wales." [16 December, 1881.]

Preamble.

WHEREAS a Society called (with the sanction of Her Most Gracious Majesty the Queen) "The Royal Society of New South Wales" has under certain rules and by-laws been formed at Sydney in the Colony of New South Wales for the encouragement of studies and investigations in Science Art Literature and Philosophy And whereas the Council of the said Society is at the present time composed of the following office-bearers and members His Excellency the Right Honorable Lord Augustus Loftus P.C. G.C.B. Honorary President The Honorable John Smith C.M.G. M.D. LL.D. President and Charles Moore Esquire F.L.S. Director of the Botanic Gardens Sydney and Henry Chamberlaine Russell Esquire B.A. (Sydney) F.R.A.S. F.M.S. London Government Astronomer for New South Wales Vice-Presidents and H. G. A. Wright Esquire M.R.C.S. Honorary Treasurer Archibald Liversidge Esquire Associate of the Royal School of Mines London Fellow of the Institute of Chemistry of Great Britain and Ireland and Professor of Geology and Mineralogy in the University of Sydney and Carl Adolph Leibius Esquire Doctor of Philosophy of the University of Heidelberg Fellow of the Institute of Chemistry of Great Britain and Ireland Honorary Secretaries W. A. Dixon Fellow of the Institute of Chemistry of Great Britain and Ireland G. D. Hirst Esquire Robert Hunt Esquire Associate of the Royal School of Mines London Deputy Master Sydney Branch Royal Mint Eliezer L. Montefiore Esquire Christopher Rolleston Esquire C.M.G.

Charles Smith Wilkinson Esquire Government Geologist Members of the Council And whereas it is expedient that the said Society should be incorporated and should be invested with the powers and authorities hereinafter contained Be it therefore enacted by the Queen's Most Excellent Majesty by and with the advice and consent of the Legislative Council and Legislative Assembly of New South Wales in Parliament assembled and by the authority of the same as follows :—

Interpretation clause.

1. For the purposes of this Act the following words in inverted commas shall unless the context otherwise indicate bear the meaning set against them respectively—

"Corporation" the Society hereby incorporated

"Council" the Members of the Council at any duly convened meeting thereof at which a quorum according to the by-laws at the time being shall be present

"Secretary" such person or either one of such persons who shall for the time being be the Secretary or Secretaries honorary or otherwise of the said Society (saving and excepting any Assistant Secretary of the said Society).

Incorporation clause.

2. The Honorary President the President Vice-Presidents Officers and Members of the said Society for the time being and all persons who shall in manner provided by the rules and by-laws for the time being of the said Society become members thereof shall be for the purposes hereinafter mentioned a body corporate by the name or style of "The Royal Society of New South Wales" and by that name shall and may have perpetual succession and a common seal and shall and may enter into contracts and sue and be sued plead and be impleaded answer and be answered unto defend and be defended in all Courts and places whatsoever and may prefer lay and prosecute any indictment information and prosecution against any person whomsoever and any summons or other writ and any notice or other proceeding which it may be requisite to serve upon the Corporation may be served upon the Secretary or one of the Secretaries as the case may be or if there be no Secretary or if the Secretaries or Secretary be absent from the Colony then upon the President or either of the Vice-Presidents.

Rules and by-laws.

3. The present rules and by-laws of the said Society shall be deemed and considered to be and shall be the rules and by-laws of the said Corporation save and except in so far as any of them are or shall or may be altered varied or repealed under the powers for that purpose therein contained or are

or may be inconsistent or incompatible with or repugnant to any of the provisions of this Act or any of the laws now or hereafter to be in force in the said Colony.

Power to acquire and hold and to sell lands &c.

4. The Corporation shall have power to purchase acquire and hold lands and any interest therein and also to sell and dispose of the said lands or any interest therein and all lands tenements hereditaments and other property of whatever nature now belonging to the said Society under the said rules and by laws or vested in Trustees for them shall on the passing of this Act be vested in and become the property of the said Corporation subject to all charges claims and demands in anywise affecting the same.

Ordinary business to be managed by the Council.

5. The ordinary business of the Corporation in reference to its property shall be managed by the Council and it shall not be lawful for individual members to interfere in any way in the management of the affairs of the Corporation except as by the rules and by laws for the time being shall be specially provided.

Powers of Council.

6. The Council shall have the general management and superintendence of the affairs of the Corporation and excepting the appointment of President and Vice-Presidents and other honorary officers who shall be appointed as the by-laws of the Society shall from time to time provide the Council shall have the appointment of all officers and servants required for carrying out the purposes of the Society and of preserving its property and it may also define the duties and fix the salaries of all officers Provided that if a vacancy shall occur in the Council during any current year of the Society's proceedings it shall be lawful for the Council to elect a member of the Society to fill such vacancy for the unexpired portion of the then current year The Council may also purchase or rent land houses or offices and erect buildings or other structures for any of the purposes for which the Society is hereby incorporated and may borrow money for the purposes of the Corporation on mortgages of the real and chattel property of the Corporation or any part thereof or may borrow money without security provided that the amount so borrowed without security shall never exceed in the aggregate the amount of the income of the Corporation for the last preceding year and the Council may also settle and agree to the covenants powers and authorities to be contained in the securities aforesaid.

Liability members

7. In the event of the funds and property of the Corporation being insufficient to meet its engagements each member thereof shall in addition to his subscription for the

then current year be liable to contribute a sum equal thereto towards the payment of such engagements but shall not be otherwise individually liable for the same and no member who shall have commuted his annual subscription shall be so liable for any amount beyond that of one year's subscription.

Custody of common seal.

8. The Council shall have the custody of the common seal of the Corporation and have power to use the same in the affairs and business of the Corporation and for the execution of any of the securities aforesaid and may under such seal authorize any person without such seal to execute any deed or deeds and do such other matter as may be required to be done on behalf of the Corporation but it shall not be necessary to use the said seal in respect of the ordinary business of the Corporation nor for the appointment of their Secretaries Solicitor or other officers.

Certified copy of rules and by-laws to be evidence.

9. The production of a printed or written copy of the rules and by-laws of the Corporation certified in writing by the Secretary or one of the Secretaries as the case may be to be a true copy and having the common seal of the Corporation affixed thereto shall be conclusive evidence in all Courts of such rules and by-laws and of the same having been made under the authority of this Act.

Elections not made in due time may be made subsequently.

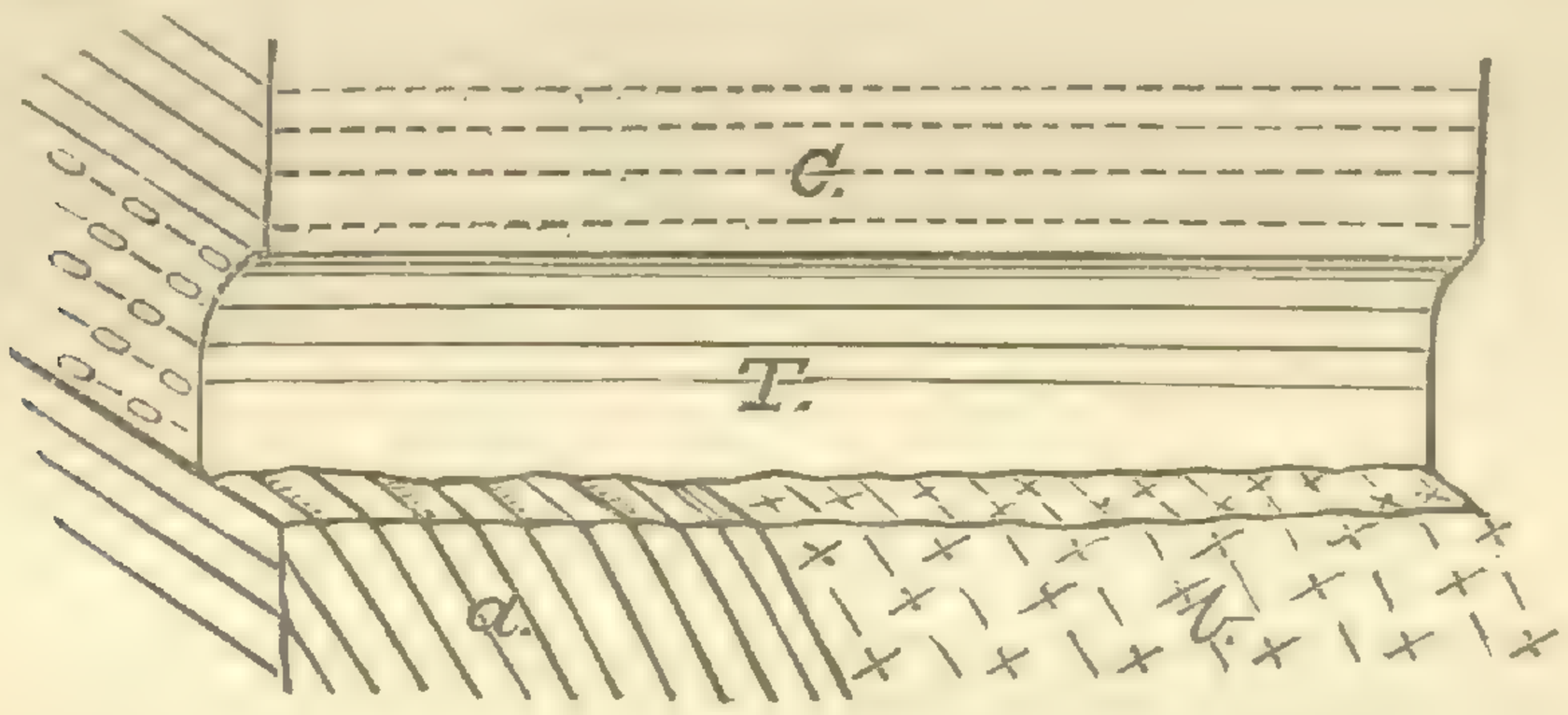
10. In case any of the elections directed by the rules and by-laws for the time being of the Corporation to be made shall not be made at the times required it shall nevertheless be competent to the Council or to the members as the case may be to make such elections respectively at any ordinary meeting of the Council or at any annual or special general meeting held subsequently.

Secretary may represent Corporation for certain purposes.

11. The Secretary or either one of the Secretaries may represent the Corporation in all legal and equitable proceedings and may for and on behalf of the Corporation make such affidavits and do such acts and sign such documents as are or may be required to be done by the plaintiff or complainant or defendant respectively in any proceedings to which the Corporation may be parties.

I was not able to examine the section of this shaft as it is lined, but some of the material on the surface, which is included in the first 90 feet of sinking, appears to consist of a fine-grained felspathic ash, which has been converted, at places, by decomposition into clay, and these ash beds are found in other sections underlying the basalts.

The bottom in Bailey's mine is of great interest. It consists of felspar porphyry in part, resting upon slates, each of these constituting the bottom in different parts of the mine. The following section will illustrate their relations, and is taken along the course of the tunnel :—



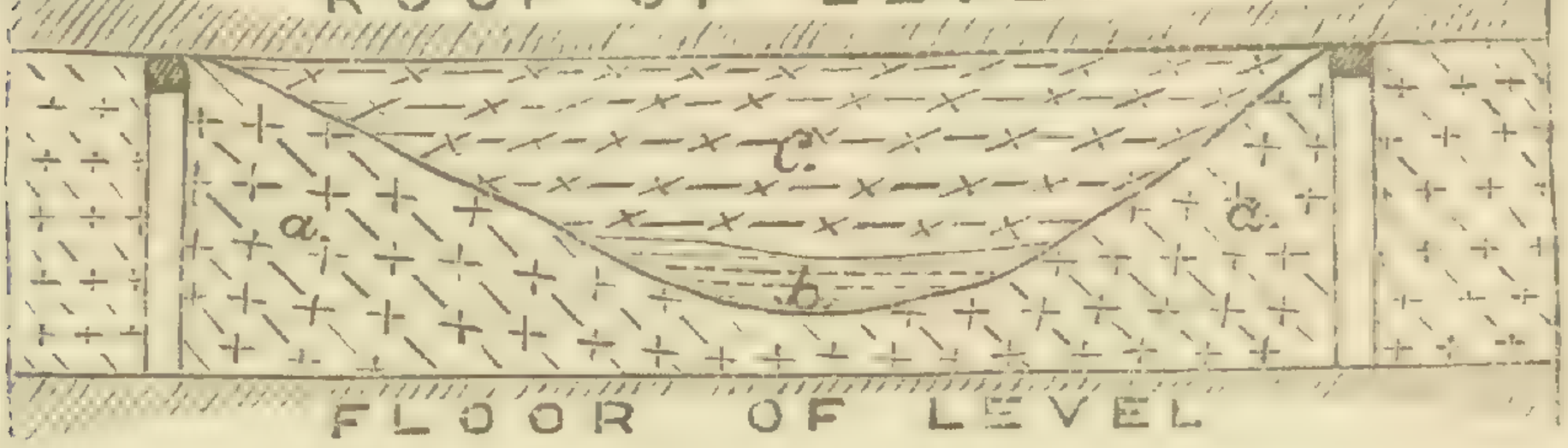
Section along tunnel in Bailey's Claim.

T. Tunnel from which wash-dirt has been removed :—

a. Slates. b. Felspar porphyry. c. Sediment overlying the tin-wash.

and I believe a similar section was met with in the old workings.

This felspar porphyry, which is called granite locally, is looked upon as the main bottom in the district, and, as a general rule, such is undoubtedly the case. It is of the greatest importance, however, to place on record the fact that at one point in this mine there is an undoubted instance of a tin gutter on this rock, the lead of tin being overlain by a rock which corresponds in all respects with the lower one. This section is cut across by a small prospecting drive, in the side of which it can be seen, as follows :—



Section along prospecting drive in Bailey's Mine.

a. Felspar porphyry. b. Tin-wash. c. Felspar porphyry (tufa ?).

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RULES.

(*Revised October* 1*st*, 1879.)

Additional Rules adopted November 5*th*, 1884, *marked thus*, Xa, *&c.*

Object of the Society.

I. The object of the Society is to receive at its stated meetings original papers on Science, Art, Literature, and Philosophy, and especially on such subjects as tend to develop the resources of Australia, and to illustrate its Natural History and Productions.

Honorary President.

II. The Governor of New South Wales shall be *ex officio* Honorary President of the Society.

Other Officers.

III. The other Officers of the Society shall consist of a President, who shall hold office for one year only, but shall be eligible for re-election after the lapse of one year; two Vice-Presidents, a Treasurer, and one or more Secretaries, who, with six other members, shall constitute a Council for the management of the affairs of the Society.

Election of Officers and Council.

IV. The President, Vice-Presidents, Secretaries, Treasurer, and the six other members of Council, shall be elected annually by ballot at the General Meeting in the month of May.

V. It shall be the duty of the Council each year to prepare a list containing the names of members whom they recommend for election to the respective offices of President, Vice-Presidents, Hon. Secretaries and Hon. Treasurer, together with the names of six other members whom they recommend for election as ordinary members of Council.

The names thus recommended shall be proposed at one meeting of the Council, and agreed to at a subsequent meeting.

Such list shall be suspended in the Society's Rooms, and a copy shall be sent to each ordinary member not less than fourteen days before the day appointed for the Annual General Meeting.

Va. There shall be elected on to the Council for each ensuing year, at least two and not more than three members of the Society who were not members of the Council for the previous year.

VI. Each member present at the Annual General Meeting shall have the power to alter the list of names recommended by the Council, by adding to it the names of any eligible members not already included in it and removing from it an equivalent number of names, and he shall use this list with or without such alterations as a balloting list at the election of Officers and Council.

The name of each member voting shall be entered into a book, kept for that purpose, by two Scrutineers elected by the members present.

No ballot for the election of members of Council, or of new members, shall be valid unless twenty members at least shall record their votes.

Vacancies in the Council during the year.

VII. Any vacancies occurring in the Council of Management during the year may be filled up by the Council.

Candidates for admission.

VIII. Candidates must be at least twenty-one years of age.

Every candidate for admission as an ordinary member of the Society shall be recommended according to a prescribed form of certificate by not less than three members, to two of whom the candidate must be personally known.

Such certificate must set forth the names, place of residence, and qualifications of the candidate.

The certificate shall be read at the three Ordinary General Meetings of the Society next ensuing after its receipt, and

during the intervals between those three meetings, it shall be suspended in a conspicuous place in one of the rooms of the Society.

The vote as to admission shall take place by ballot, at the Ordinary General Meeting at which the certificate is appointed to be read the third time, and immediately after such reading.

At the ballot the assent of at least four-fifths of the members voting shall be requisite for the admission of the candidate.

Entrance Fee and Subscriptions.

IX. The entrance money paid by members on their admission shall be Two Guineas; and the annual subscription shall be Two Guineas, payable in advance; but members elected prior to December, 1879, shall be required to pay an annual subscription of One Guinea only as heretofore.

The amount of ten annual payments may be paid at any time as a life composition for the ordinary annual payment.

IXA. The entrance fee and first annual subscription shall be paid within two months from the date of election; otherwise the election shall be void.

The Council may, however, in special cases, extend the period within which these payments must be made.

IXB. Composition fees shall be treated as capital, and shall be devoted to the Building Fund Account, or invested.

New Members to be informed of their election.

X. Every new member shall receive due notification of his election, and be supplied with a copy of the obligation (No. 3 in Appendix), together with a copy of the Rules of the Society, a list of members, and a card of the dates of meeting.

Members shall sign Rules—Formal admission.

XI. Every member who has complied with the preceding Rules shall at the first Ordinary General Meeting at which he shall be present sign a duplicate of the aforesaid obligation in a

book to be kept for that purpose, after which he shall be presented by some member to the Chairman, who, addressing him by name, shall say :—"In the name of the Royal Society of New South Wales I admit you a member thereof."

Annual subscriptions, when due.

XII. Annual subscriptions shall become due on the 1st of May for the year then commencing. The entrance fee and first year's subscription of a new member shall become due on the day of his election.

XIIA. Persons elected on or after the first day of October in any year shall pay the annual contribution as in advance for the following year, but in every case within two months after notification of their election has been made to them by the Honorary Secretary.

Members whose subscriptions are unpaid not to enjoy privileges.

XIII. An elected member shall not be entitled to attend the meetings or to enjoy any privilege of the Society, nor shall his name be printed in the list of the Society, until he shall have paid his admission fee and first annual subscription, and have returned to the Secretaries the obligation signed by himself.

Subscriptions in arrears.

XIV. Members who have not paid their subscriptions for the current year, on or before the 31st of May, shall be informed of the fact by the Hon. Treasurer.

No member shall be entitled to vote or hold office while his subscription for the previous year remains unpaid.

The name of any member who shall be two years in arrears with his subscriptions shall be erased from the list of members, but such member may be re-admitted on giving a satisfactory explanation to the Council, and on payment of arrears.

At the meeting held in July, and at all subsequent meetings for the year, a list of the names of all those members who are in

arrears with their annual subscriptions shall be suspended in the Rooms of the Society. Members shall in such cases be informed that their names have been thus posted.

XIVA. Any member in arrears shall cease to receive the Society's publications, and shall not be entitled to any of the privileges of the Society until such arrears are paid.

Resignation of Members.

XV. Members who wish to resign their membership of the Society are requested to give notice in writing to the Honorary Secretaries, and are required to return all books or other property belonging to the Society.

Expulsion of Members.

XVI. A majority of members present at any ordinary meeting shall have power to expel an obnoxious member from the Society, provided that a resolution to that effect has been moved and seconded at the previous ordinary meeting, and that due notice of the same has been sent in writing to the member in question, within a week after the meeting at which such resolution has been brought forward.

Honorary Members.

XVII. The Honorary Members of the Society shall be persons who have been eminent benefactors to this or some other of the Australian Colonies, and distinguished patrons and promoters of the objects of the Society. Every person proposed as an Honorary Member must be recommended by the Council and elected by the Society. Honorary Members shall be exempted from payment of fees and contributions: they may attend the meetings of the Society, and they shall be furnished with copies of the publications of the Society, but they shall have no right to hold office, to vote, or otherwise interfere in the business of the Society.

The number of Honorary Members shall not at any one time exceed twenty, and not more than two Honorary Members shall be elected in any one year.

Corresponding Members.

XVIII. Corresponding Members shall be persons, not resident in New South Wales, of eminent scientific attainments, who may have furnished papers or otherwise promoted the objects of the Society.

Corresponding Members shall be recommended by the Council, and be balloted for in the same manner as ordinary Members.

Corresponding Members shall possess the same privileges only as Honorary Members.

The number of Corresponding Members shall not exceed twenty-five, and not more than three shall be elected in any one year.

Ordinary General Meetings.

XIX. An Ordinary General Meeting of the Royal Society, to be convened by public advertisement, shall take place at 8 p.m., on the first Wednesday in every month, during the last eight months of the year; subject to alteration by the Council with due notice.

Order of Business.

XX. At the Ordinary General Meetings the business shall be transacted in the following order, unless the Chairman specially decide otherwise:—

1—Minutes of the preceding Meeting.
2—New Members to enrol their names and be introduced.
3—Ballot for the election of new Members.
4—Candidates for membership to be proposed.
5—Business arising out of Minutes.
6—Communications from the Council.
7—Communications from the Sections.
8—Donations to be laid on the Table and acknowledged.
9—Correspondence to be read.
10—Motions from last Meeting.
11—Notices of Motion for the next Meeting to be given in.
12—Papers to be read.
13—Discussion.
14—Notice of Papers for the next Meeting.

XXA. At the ordinary meetings of the Society nothing relating to its regulations or management, except as regards the election or ejection of members, shall be brought forward, unless the same shall have been announced in the notice calling the meeting, or be otherwise provided for in these Rules.

XXB. A special meeting of the Society may be called by the Council, provided that seven days notice be given by advertisement, or shall be so called on a requisition signed by at least twenty-five members of the Society, to consider any special business thus notified.

Annual General Meeting.—Annual Reports.

XXI. A General Meeting of the Society shall be held annually in May, to receive a Report from the Council on the state of the Society, and to elect Officers for the ensuing year. The Treasurer shall also at this meeting present the annual financial statement.

Admission of Visitors.

XXII. Every ordinary member shall have the privilege of introducing two friends as visitors to an Ordinary General Meeting of the Society or its Sections, on the following conditions :—

1. That the name and residence of the visitors, together with the name of the member introducing them, be entered in a book at the time.
2. That they shall not have attended two consecutive meetings of the Society or of any of its Sections in the current year.

The Council shall have power to introduce visitors irrespective of the above restrictions.

Council Meetings.

XXIII. Meetings of the Council of Management shall take place on the last Wednesday in every month, and on such other days as the Council may determine.

XXIIIA. The President or Hon. Secretaries, or any three Members of the Council, may call a meeting of the Council, provided that due notice of the same has been sent to each Member of the Council at least three days before such meeting.

Absence from Meetings of Council.—Quorum.

XXIV. Any member of the Council absenting himself from three consecutive meetings of the Council, without giving a satisfactory explanation in writing, shall be considered to have vacated his office. No business shall be transacted at any meeting of the Council unless three members at least are present.

Duties of Secretaries.

XXV. The Honorary Secretaries shall perform, or shall cause the Assistant Secretary to perform, the following duties :—

1. Conduct the correspondence of the Society and Council.
2. Attend the General Meetings of the Society and the meetings of the Council, to take minutes of the proceedings of such meetings, and at the commencement of such to read aloud the minutes of the preceding meeting.
3. At the Ordinary Meetings of the members, to announce the presents made to the Society since their last meeting ; to read the certificates of candidates for admission to the Society, and such original papers communicated to the Society as are not read by their respective authors and the letters addressed to it.
4. To make abstracts of the papers read at the Ordinary General Meetings, to be inserted in the Minutes and printed in the Proceedings.
5. To edit the Transactions of the Society, and to superintend the making of an Index for the same.
6. To be responsible for the arrangement and safe custody of the books, maps, plans, specimens, and other property of the Society.

7. To make an entry of all books, maps, plans, pamphlets, &c., in the Library Catalogue, and of all presentations to the Society in the Donation Book.

8. To keep an account of the issue and return of books, &c., borrowed by members of the Society, and to see that the borrower, in every case, signs for the same in the Library Book.

9. To address to every person elected into the Society a printed copy of the Forms Nos. 2 and 3 (in the Appendix), together with a list of the members, a copy of the Rules, and a card of the dates of meeting; and to acknowledge all donations made to the Society, by Form No. 6.

10. To cause due notice to be given of all Meetings of the Society and Council.

11. To be in attendance at 4 p.m. on the afternoon of Wednesday in each week during the session.

12. To keep a list of the attendances of the members of the Council at the Council Meetings and at the ordinary General Meetings, in order that the same may be laid before the Society at the Annual General Meeting held in the month of May.

The Honorary Secretaries shall, by mutual agreement, divide the performance of the duties above enumerated.

The Honorary Secretaries shall, by virtue of their office, be members of all Committees appointed by the Council.

Contributions to the Society.

XXVI. Contributions to the Society, of whatever character, must be sent to one of the Secretaries, to be laid before the Council of Management. It will be the duty of the Council to arrange for promulgation and discussion at an Ordinary Meeting such communications as are suitable for that purpose, as well as to dispose of the whole in the manner best adapted to promote the objects of the Society.

XXVIA. The original copy of every paper communicated to the Society, with the illustrative drawings, shall become the property of the Society unless stipulation be made to the contrary; and authors shall not be at liberty, save by permission of the Council, to publish the papers they have communicated, until such papers or abstracts of them, have appeared in the Journal or other publications of the Society.

XXVIB. If any paper of importance is communicated during the recess, the same may be ordered for publication by the Council, without being read to the Society.

Management of Funds.

XXVII. The funds of the Society shall be lodged at a Bank named by the Council of Management. Claims against the Society, when approved by the Council, shall be paid by the Treasurer.

All cheques shall be countersigned by a member of the Council.

*Money Grants.**

XXVIII. Grants of money in aid of scientific purposes from the funds of the Society—to Sections or to members—shall expire on the 1st of November in each year. Such grants, if not expended, may be re-voted.

XXIX. Such grants of money to Committees and individual members shall not be used to defray any personal expenses which a member may incur.

Audit of Accounts.

XXX. Two Auditors shall be appointed annually, at an Ordinary Meeting, to audit the Treasurer's Accounts. The accounts as audited to be laid before the Annual Meeting in May.

---

* Applicants for money grants are required to supply the following information :—

1. The nature of the research and the scientific results expected to follow therefrom.
2. The amount asked for.
3. Whether any previous grant has been received from any source, and, if so, with what results.
4. Whether any portion of the grant is to be devoted to personal remuneration.
5. What apparatus (if any) of permanent value will be required.

Property of the Society to be vested in the President, &c.

XXXI. All property whatever belonging to the Society shall be vested in the President, Vice-Presidents, Hon. Treasurer, and Hon. Secretaries for the time being, in trust for the use of the Society; but the Council shall have control over the disbursements of the funds and the management of the property of the Society.

SECTIONS.

XXXII. To allow those members of the Society who devote attention to particular branches of science fuller opportunities and facilities of meeting and working together with fewer formal restrictions than are necessary at the general Monthly Meetings of the Society,—Sections or Committees may be established in the following branches of science:—

Section A.—Astronomy, Meteorology, Physics, Mathematics, and Mechanics.

Section B.—Chemistry and Mineralogy, and their application to the Arts and Agriculture.

Section C.—Geology and Palæontology.

Section D.—Biology, *i.e.*, Botany and Zoology, including Entomology.

Section E.—Microscopical Science.

Section F.—Geography and Ethnology.

Section G.—Literature and the Fine Arts, including Architecture.

Section H.—Medical.

Section I.—Sanitary and Social Science and Statistics.

Section Committees—Card of Meetings.

XXXIII. The first meeting of each Section shall be appointed by the Council. At that meeting the members shall elect their own Chairman, Secretary, and a Committee of four; and arrange the days and hours of their future meetings. A card showing the dates of each meeting for the current year shall be printed for distribution amongst the members of the Society.

Membership of Sections.

XXXIV. Only members of the Society shall have the privilege of joining any of the Sections.

Reports from Sections.

XXXV. There shall be for each Section a Chairman to preside at the meetings, and a Secretary to keep minutes of the proceedings, who shall jointly prepare and forward to the Hon. Secretaries of the Society, on or before the 7th of December in each year, a report of the proceedings of the Section during that year, in order that the same may be transmitted to the Council.

Reports.

XXXVI. It shall be the duty of the President, Vice-Presidents, and Honorary Secretaries to annually examine into and report to the Council upon the state of—

1. The Society's house and effects.
2. The keeping of the official books and correspondence.
3. The library, including maps and drawings.
4. The Society's cabinets and collections.

Cabinets and Collections.

XXXVII. The keepers of the Society's cabinets and collections shall give a list of the contents, and report upon the condition of the same to the Council annually.

Documents.

XXXVIII. The Honorary Secretaries and Honorary Treasurer shall see that all documents relating to the Society's property, the obligations given by members, the policies of insurance, and other securities shall be lodged in the Society's iron chest, the contents of which shall be inspected by the Council once in every year; a list of such contents shall be kept, and such list shall be signed by the President or one of the Vice-Presidents at the annual inspection.

Branch Societies.

XXXIX. The Society shall have power to form Branch Societies in other parts of the Colony.

Library.

XL. The members of the Society shall have access to, and shall be entitled to borrow books from the Library, under such regulations as the Council may think necessary.

Alteration of Rules.

XLI. No alteration of, or addition to, the Rules of the Society shall be made unless carried at two successive General Meetings, at each of which twenty-five members at least must be present.

THE LIBRARY.

1. The Library shall be open for consultation and for the issue and return of books daily (except Saturday), from 9·30 a.m. to 1 p.m., and 2 to 6 p.m., and on Saturdays from 9·30 a.m. to 1·30 p.m.

1A. The Library will not be open on public holidays.

2. No book shall be issued without being signed for in the Library Book.

3. Members are not allowed to have more than two volumes at a time from the Library, without special permission from one of the Honorary Secretaries, nor to retain a book for a longer period than fourteen days; but when a book is returned by a member it may be borrowed by him again, provided it has not been bespoken by any other member. Books which have been bespoken shall circulate in rotation, according to priority of application.

4. Scientific Periodicals and Journals will not be lent until the volumes are completed and bound.

4A. Dictionaries, Encyclopædias, and other works of reference and cost, Atlases, Books and Illustrations in loose sheets, Drawings, Prints and unbound numbers of Periodicals and Works, Journals, Transactions and Proceedings of Societies or Institutions, Works of a Series, Maps or Charts, are not to be removed from the Library without the written order of the President or one of the Hon. Secretaries.

5. Members retaining books longer than the time specified shall be subject to a fine of sixpence per week for each volume.

6. The books which have been issued shall be called in by the Secretaries twice a year; and in the event of any book not being returned on those occasions, the member to whom it was issued shall be answerable for it, and shall be required to defray the cost of replacing the same.

7. No stranger shall be admitted to the Library except by the introduction of a member, whose name, together with that of the visitor, shall be inserted in a book kept for that purpose.

8. Members shall not lay the paper upon which they are writing on any Book or Map.

No tracings shall be made without express permission from the Hon. Secretaries.

Form No. 1.

ROYAL SOCIETY OF NEW SOUTH WALES.

Certificate of a Candidate for Election.

Name

Qualification or occupation

Address

being desirous of admission into the Royal Society of New South Wales, we, the undersigned members of the Society, propose and recommend him as a proper person to become a member thereof.

Dated this day of 18 .

FROM PERSONAL KNOWLEDGE.	FROM GENERAL KNOWLEDGE.

Signature of candidate

Date received 18 .

N.B.—This certificate must be signed by three or more members, to two of whom the candidate must be personally known. The candidate must be at least twenty-one years of age. This certificate has to be read at three ordinary general meetings of the Society.

Form No. 2.

ROYAL SOCIETY OF NEW SOUTH WALES.

The Society's House,

Sir, Sydney, 18 .

I have the honour to inform you that you have this day been elected a member of the Royal Society of New South Wales, and I beg to forward to you a copy of the Rules of the Society, a printed copy of an obligation, a list of members, and a card announcing the dates of meeting during the present session.

According to the Regulations of the Society (*vide* Rule No. 9), you are required to pay your admission fee of two guineas, and annual subscription of two guineas for the current year, before admission. You are also requested to sign and return the enclosed form of obligation at your earliest convenience.

I have, &c.,

To ——— Hon. Secretary.

Form No. 3.

ROYAL SOCIETY OF NEW SOUTH WALES.

I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the Royal Society of New South Wales, and to observe its Rules and By-laws, as long as I shall remain a member thereof.

Signed,

Address

Date

Form No. 4.

ROYAL SOCIETY OF NEW SOUTH WALES.

The Society's House,

Sir, Sydney, 18 .

I have the honour to inform you that your annual subscription of for the current year became due to the Royal Society of New South Wales on the 1st of May last.

It is requested that payment may be made by cheque or Post Office order drawn in favour of the Hon. Treasurer.

I have, &c.,

To Hon. Treasurer.

Form No. 5.

ROYAL SOCIETY OF NEW SOUTH WALES.

The Society's House,

Sir, Sydney, 18 .

I am desired by the Royal Society of New South Wales to forward to you a copy of its Journal for the year 18 , as a donation to the library of your Society.

I am further requested to mention that the Society will be thankful to receive such of the very valuable publications issued by your Society as it may feel disposed to send.

I have the honour to be,

Sir,

Your most obedient servant,

Hon. Secretary.

Form No. 6.

ROYAL SOCIETY OF NEW SOUTH WALES.

The Society's House,

Sir, Sydney, 18 .

On behalf of the Royal Society of New South Wales, I beg to acknowledge the receipt of and I am directed to convey to you the best thanks of the Society for your most valuable donation.

I have the honour to be,

Sir,

Your most obedient servant,

Hon. Secretary.

Form No. 7.

Balloting List for the Election of the Officers and Council.

ROYAL SOCIETY OF NEW SOUTH WALES.

Date.....

BALLOTING LIST for the election of the Officers and Council.

Present Council.	Names proposed as Members of the new Council.	
	President.	
	Vice-Presidents.	
	Hon. Treasurer.	
	Hon. Secretaries.	
	Members of Council.	

If you wish to substitute any other name in place of that proposed, erase the printed name in the second column, and write opposite to it, in the third, that which you wish to substitute.

LIST OF THE MEMBERS

OF THE

Royal Society of New South Wales.

P Members who have contributed papers which have been published in the Society's Transactions or Journal; papers published in the Transactions of the Philosophical Society are also included. The numerals indicate the number of such contributions.

† Members of the Council.

‡ Life Members.

Elected.		
1877		Abbott, Joseph Palmer, M.L.A., 6 Wentworth Court, Elizabeth-street.
1877	P 1	Abbott, Thomas Kingsmill, S.M., Central Police Office, Sydney.
1877	P 3	**Abbott, W. E., Abbotsford, Wingen.**
1877		Adams, Francis, Australian Joint Stock Bank, Sydney.
1864		Adams, P. F., Surveyor General, Kirribilli Point, St. Leonards.
1878		**Alexander, George M., Hunter-street.**
1874		**Alger, John, Union Club.**
1868		**Allerding, F., 25 Hunter-street.**
1873		**Allerding, H. R., 25 Hunter-street.**
1856		Allwood, Rev. Canon, B.A. *Cantab.*, "Rorklands," Edgecliff Road, Woollahra.
1885		Allworth Joseph Witter, District Surveyor, East Maitland.
1881		**Amos, Robert, "Renneil," Elizabeth Bay Road.**
1877		Anderson, H. C. L., M.A., "Aberfeldie," Summer Hill.
1876		Atchison, Cunningham Archibald, C.E., North Shore.
1873		Atherton, Ebenezer, M.R.C.S. *Eng.*, Macquarie-street North.
1885		Baas, James Ranson, C.E., 4, Macleay Villas, Rushcutters' Bay.
1878		Backhouse, Alfred P., M.A., District Court Judge, "Melita," Elizabeth Bay.
1877		Baker, E. A., M.L.A., Erith Colliery, Bundanoon.
1878		Balfour, James, National Bank of Australasia, 60, Pitt-street.
1881		Barff, H. E., M.A., Registrar, Sydney University.
1878		Barker, Francis Lindsay, 86 Pitt-street.
1886		Barker, W. Mandeville, Longueville Chambers, Young-street.
1884		Barry, The Most Rev. Alfred, D.D., D.C.L., Primate, Bishopscourt, Randwick.
1875		Bartels, W. C. W., Richmond Terrace.
1876		Bassett, W. F., M.R.C.S., *Eng.*, Bathurst.
1878		Bayley, George W. A., Railway Department, Phillip-street.
1884		Baynes, Richard B., Victoria Barracks.
1875		Bedford, W. J. G., M.R.C.S. *Eng.*, "Waratah," Newtown, Hobart, Tasmania.

Elected.		
1868		Beilby, E. T., 91, Pitt-street.
1875		Belgrave, Thomas B., M.D. *Edin.*, M.R.C.S. *Eng.*, Phillip-street
1877		Belfield, Algernon H., Eversleigh.
1875		Belisario, John, M.D., Lyons' Terrace.
1876		Benbow, Clement A., 30, College-street.
1869	P 2	Bensusan, S. L., 44, Castlereagh-street.
1877		Bennett, George F., C.M.Z.S., Toowoomba, Queensland.
1878		Berney, Augustus, H. M. Customs, Sydney.
1884		Binsteal, Wm. H. Glenthorne, Boulevard, Petersham.
1878		Black, Reginald James, M.L.A., "Traveleyn," Darling Point Road, Woollahra.
1878		Black, Morrice A., F.I.A., Actuary, Australian Mutual Provident Society, Pitt-street.
1886		Blacket, Arthur, Architect, Bond-street.
1880		Blackmann, C. H. E., 375, George-street.
1877		Bladen, Thomas, c/o Mr. Frank Bladen, Government Printing Office.
1883		Blaxland, Herbert, M.R.C.S.E., L.R.C.P. *Lond.*, Hospital for the Insane, Callan Park.
1872		Bolding, H. J., P.M., Raymond Terrace, Hunter River.
1879		‡Bond, Albert, Bell's Chambers, Pitt-street.
1874		Bowen, George M. C., "Keston," Kirribilli Point, North Shore.
1886		Bowker, R. S., L.R.C.P. *Edin.*, M.R.C.S. *Eng.*, 17, Clarence-street.
1886		Bowman, Arthur, 163, Phillip-street.
1876		Brady, Andrew John, Lic. K. & Q. Coll. Phys. *Irel.*, Lic. R. Coll. Sur. *Irel.*, 3, Lyons' Terrace.
1871	P 1	Brazier, John, F.L.S., C.M.Z.S., Corr. M.R.S., Tas., 82, Windmill-street.
1879		Brindley, Thomas, St. Stephen's House, Bligh-street, Newtown.
1878		‡Brooks, Joseph, F.R.G.S., "Hope Bank," Nelson-st., Woollahra.
1886		Brown, David, "Kallara," Bourke.
1876		Brown, Henry Joseph, Newcastle.
1880		Brown, John Studd, Dubbo.
1877		Bundock, W. C., "Wyangarie," Casino.
1877		Burnell, Arthur, "Clapton," Forbes-street.
1875		Burton, Edmund, Land Titles Office, Elizabeth-street North.
1875		Busby, The Hon. William, M.L.C., "Redleaf," South Head Road, Woollahra.
1880		Bush, Thomas James, Engineer's Office, Gas Works, Sydney.
1876		Cadell, Alfred, Vegetable Creek, New England.
1876		Cadell, Hon. Thomas, M.L.C., Australian Club.
1880		Caird, George S., "Lillingstone," Ocean-street, Woollahra.
1876		Campbell, Allan, L.R.C.P., *Glasgow*, Yass.
1876		Campbell, The Hon. Alexander, M.L.C., "Rosemont," Woollahra.
1868		Campbell, The Hon. Charles, M.L.C., c/o F. Campbell, Esq., "Yarralumba," Queanbeyan
1879		Campbell, Revd. Joseph, M.A., F.G.S., "The Parsonage," Glen Innes.
1870		Cane, Alfred, 110, Victoria-street.
1876		Cape, Alfred J., M.A., *Syd.*, "Karoola," Edgecliff Road.
1886		Carey, John R., "Caprera," Milson's Point, St. Leonards.

Elected.		
1886		Carrington, His Excellency The Right Hon. Lord, G.C.M.G., &c., &c., &c., *Hon. President.*
1882		Carruthers, Charles Ulic, L.K.Q.C.P., L.R.C.S., *Irel.*, Montague-street, Balmain.
1885		Chadwick, Robert, "Arlington," Edgecliff Road, Woollahra.
1882		Chambers, Thos., F.R.C.P., F.R.C.S. *Edin.*, 1. Lyons' Terrace.
1879	P 1	‡Chard, J. S., District Surveyor, Armidale.
1878		Chatfield, Captn. William, Smith-street, Parramatta.
1884		Chesterman, Alfd. Hy., L.S., Surveyor General's Office.
1878		Chisholm, Edwin, M.R.C.S., E., L.S.A., &c., "Abergeldie," Victoria-street, Ashfield.
1885		Chisholm, William, M.D., *Lond.*, 199, Macquarie-street North.
1876		Codrington, John Fredk., M.R.C.S., E.; Lic. R.C. Phys., L.; Lic. R.C. Phys., *Edin.*, Orange.
1878		Collie, Revd. Robert, F.L.S., "The Manse," Wellington-street, Newtown.
1886		Collingwood, David, M.D. *Lond.*, F.R.C.S. *Eng.*, "Airedale," Summer Hill.
1878		Colquhoun, George, "Rossdhu," 72, Darlinghurst Road.
1880		Colyer, Henry Cox, M.A., "Clinton," Liverpool-street, Darlinghurst.
1876		Colyer, John Ussher Cox, "Eastwell," Bellevue, Waverley.
1856		Comrie, James, "Northfield," Kurrajong Heights.
1876		Conder, Wm., Chairman, Local Land Board, Cooma.
1882		Conlan, George Nugent, F.R.G.S., care of Mr. C. E. Riddell, Union Club.
1882		Cornwell, Samuel, Australian Brewery, Bourke-street, Redfern.
1878		Cottee, Wm. Alfred, 2, Spring-street.
1880		Cox, The Hon. George Henry, M.L.C., "Winbourn," Penrith.
1859	P 1	Cox, James, M.D. *Edin.* C.M.Z.S., F.L.S., 73, Hunter-street.
1884	P 2	Cox, Saml. Herbert, F.C.S., F.G.S., 1 Victoria Terrace, Miller-street, North Shore.
1865	P 2	Cracknell, E. C., M.I.C.E., Superintendent of Telegraphs, Telegraph Office, George-street.
1886		Crago, W. H., M.R.C.S. *Eng.*, L.R.C.P. *Lond.*, 82, William-street.
1869		Creed, The Hon. J. Mildred, M.L.C., M.R.C.S. *Eng.*, L.R.C.P., *Edin.*, Wallis-street, Woollahra.
1870		Croudace, Thomas, Lambton.
1881		Crummer, Henry, 47, Rialto Terrace, Darlinghurst.
1885		Dalton, James Neale, Head Master, The Queen's School, Sydney.
1873		Daintrey, Edwin, "Æolia," Randwick.
1876		Dansey, George Frederick, M.R.C.S. *London*, 329, Cleveland-street, Redfern.
1875		Dangar, Frederick H., "Grantham," Potts's Point.
1876		Darley, Cecil West, "Erimgh," Elizabeth Bay Road.
1877		Darley, Sir F. M., K.C.M.G., B.A., Chief Justice, Supreme Court, King-street.
1879		Davenport, Sir Samuel, K.C.M.G., "Beaumont," Adelaide, South Australia.
1886		David, T. W. Edgeworth, B.A., F.G.S., Geological Surveyor, Department of Mines, Phillip-street.

Elected.		
1878		Dean, Alexander, J.P., 54 Castlereagh-street.
1885		Deane, Henry, C.E., Gladesville.
1877		Deck, John Field. M.D., Ashfield.
1856		Deffell, George H., Chief Commissioner, Insolvency Court, Phillip-street.
1881		Delarue, Leopold H., 378, George-street.
1875		De Salis, The Hon. Leopold Fane, M.L.C., "Tharwa," Queanbeyan.
1876		Dight, Arthur, Richmond.
1875	P 9	Dixon, W. A., F.C.S., Fellow and Member Inst. of Chemistry of Gt. Britain and Irel., Lecturer on Chemistry, The Technical College, School of Arts, Pitt-street, Sydney.
1882		Dixon, Fletcher, English, Scottish, and Australian Chartered Bank, George-street.
1880		Dixson, Craig, M.B., C.M., *Edin.*, M.R.C.S., *Eng.*, M.D. *Syd.*, 2, Clarendon Terrace, Elizabeth-street.
1880		Dixson, Thomas, M.B., Mast. Surg., *Edin.*, "Ellalong," Ashfield.
1876		Docker, Ernest B., M.A. *Syd.*, "Carhullen," Granville.
1879		Docker, Wilfred L., "Nyrambla," Darlinghurst Road.
1882		Donkin, J. B., The Exchange, Sydney.
1879		Dowling, Neville, "Brougham," Wallis-street, Woollahra.
1884		Dowling, Edward, Secretary, Board of Technical Education, 129 Phillip-street.
1873		Du Faur, Eccleston, F.R.G.S., "Marfa," Croydon.
1886		Dunn, Edward C., "Ooloolang," Chandos-street, Ashfield.
1876		Eales, Hon. John, M.L.C., Duckenfield Park, Morpeth.
1886		Edmunds, Percy James, Public Training School, Fort-street.
1876		Egan, Myles, M.R.C.S. *Eng.*, 136, Elizabeth-street.
1874		Eichler, Charles F., M.D. *Heidelberg*, M.R.C.S. *Eng.*, Bridge-street.
1876		Eldred, W. H., 62, Margaret-street.
1881		Elliott, F. W., Elizabeth Bay.
1885		Ellis, Henry A., M.B., Ch. B. Univ. *Dub.*, 3, Bayswater Houses, Double Bay.
1876		Evans, George, "Como," Darling Point.
1881		Evans, Thomas, M.R.C.S., *E.*, 211, Macquarie-street North.
1881		Ewan, John Frazer, M.B., Mast. Surg. Univ. *Edin.*, c/o Messrs. John Frazer & Co., York-street.
1877		‡Fairfax, Edward R., 145, Macquarie-street.
1868		Fairfax, James R., *Herald* Office, Hunter-street.
1881		Fiaschi, Thos., M.D., M. Ch., Univ. Pisa, 39, Phillip-street.
1876		Firth, Rev. Frank, Wesleyan Parsonage, Waverley.
1874		Fischer, Carl F., M.D., M.R.C.S., *Eng.*; L.R.C.P., *Lond.*; F.G.S.; F.L.S.; F.R.M.S.; Member Imp. Botanical and Zoological Society, Vienna; Corr. Member Imp. Geographical Society, Vienna; c/o the Manager of the Bank of New Zealand, Pitt-street.

Elected.		
1856		Flavelle, John, 340, George-street.
1880		Forbes, Alexr. Leith, M.A.. Dept. of Public Instruction.
1879		‡Foreman, Joseph, M.R.C.S., L.R.C.P., *Edin.*, 161, Macquarie-street.
1881		Foster, W. J., Q.C., M.L.A., Temple Court, King-street.
1878		Fraser, Robert, Vickery's Buildings, 80A, Pitt-street.
1882		Fraser, Rev. John G., M.A., Warden of Camden College.
1883	P 1	Fraser, John, B.A., *Edin.*, LL.D., Délégué Général (pour l'Océanie), de l'Institution Ethnographique de Paris, Associate of the Victoria (Philosophical) Institute of Great Britain, c/o Rev. James Benvie, Manse, West Maitland.
1881		Furber, T. F., "Clifton," Burwood.
1880		Gardiner, Rev. Andrew, M.A., "Paxton House," Glebe Point.
1884		Gardiner, John, Chief Examiner, Department of Public Instruction, Harrow Road, Stanmore, Petersham.
1877		Garnsey, Rev. C. F., Christ Church Parsonage, Sydney.
1868	P 1	Garran, The Hon. Andrew, M.L.C., LL.D., "Strathmore," Glebe Point.
1883		Garrett, H. Edwd., M.R.C.S.E., 37, Wynard Square West.
1877		Garvan, J. P., M.L.A., East St. Leonards.
1878		Gedye, Charles Townsend, "Eastbourne," Darling Point.
1876		George, W. R., 346, George-street.
1879		Gerard, Francis, Crown Lands Office.
1884		Gibbs, J. Burton, Hosking Place, 84A, Pitt-street North.
1876		Gilchrist, W. O., c/o Messrs. Gilchrist, Watt, & Co., Spring-street.
1884		Gill, Rev. Wm. Wyatt, B.A., *Lond.*, "Persica," Illawarra Road, Marrickville.
1875		Gilliat, Henry A., Department of Mines, Phillip-street.
1876	P 3	Gipps, F. B., C.E., "Maida," Chandos street, Ashfield.
1878		Goddard, William C., The Exchange, New Pitt-street.
1876		Goode, George, M.A., M.D., M. Ch., Trin. Coll., *Dub.*, Orange.
1883		Goode, Wm. Hy., M.A., M.D., Ch.M., Diplomate in State Medicine, *Dub.*, Surgeon Royal Navy, Corres. Mem. Royal Dublin Society, Mem. Brit. Med. Assoc., Lecturer on Medical Jurisprudence, University of Sydney, 159, Macquarie-street North.
1859		Goodlet, John H., "Canterbury House," Ashfield.
1886		Graham, James, M.A., M.B., C.M., Prince Alfred Hospital, Sydney.
1876		Grahame, Hon. Wm., M.L.C., "Strathearn House," Waverley.
1885		Griffin, Gilderoy Wells, Consul for the United States of America, 12, Beresford Chambers, Castlereagh-street.
1878		Griffiths, Frederick C., "Greenknowe," 56, Macleay-street.
1877		Griffiths, G. Neville, 10, O'Connell-street.
1886		Grut, Percival de Jersey, English, Scottish, and Australian Chartered Bank, Sydney.
1877		Gurney, T. T., M.A. *Cantab.*, late Fellow of St. John's College, Cambridge, Professor of Mathematics and Natural Philosophy, University of Sydney.

Elected.		
1880		Haege, Hermann, 93, Pitt-street.
1878		Hall, Richard T., 85, Macleay-street.
1880		Halligan, Gerald H., C.E., "Eugowra," Hunter's Hill.
1882		Hammond, Mark J., M.L.A., "Endymion," Ashfield.
1882		Hankins, Geo. Thos., M.R.C.S.E., 3 Lyons' Terrace, Hyde Park.
1877	P 3	Hargrave, Lawrence, "Ravensbourne," Rushcutter's Bay Road.
1881		‡Harris, John, M.L.A., "Bulwarra," Jones-street, Ultimo.
1877		‡Harrison, L. M., Macquarie Place.
1878	P 2	Hart, Ludovico, c/o Messrs. Hart & Curtis, "Avenel," High-street, St. Kilda.
1884		Haswell, William Aitcheson, M.A., B Sc., F.L.S., Demonstrator of Comparative Anatomy and Physiology, University of Sydney Australian Club.
1877	P 1	Hawkins, H. S., M.A., Balmain.
1874		Hay, The Hon. Sir John, K.C.M.G., M.L.C., A.M. *Aberdeen.* President of the Legislative Council, Rose Bay, Woollahra.
1876		Heaton, J. H., M.P., St. Stephen's Club, Westminster, London.
1881		Helms, Albert, Ph. D., *Berlin*, Sydney University.
1877		Henry, James, 750, George-street.
1884		Henson, Joshua B., C.E., Assistant City Engineer, Town Hall, Sydney.
1878		Herborn, E. W. L., "Flinton," Burwood.
1878		Herborn, Eugene, Licensed Surveyor, Beresford Chambers, 52, Castlereagh-street.
1876		Heron, Henry, solicitor, 53, Hunter-street.
1878		Hewett, Thomas Edward, Technical College, Sydney.
1885		Heydon, L. F., M.L.A., Elizabeth-street.
1879		Higgins, R. G., Kickabeli Station, Quirindi.
1879		Hills, Robert, Elizabeth Bay.
1879		Hitchins, Edwd. Lytton, "Florence," Victoria-street North, Darlinghurst.
1876	P 2	Hirst, Geo. D., 377, George-street.
1882		Hoff, August (changed name from Duckershoff) M.D. Univ. *Leipzig*, 197, Liverpool-street.
1876		Holroyd, Arthur Todd, M.B. *Cantab.*, M.D. *Edin.*, F.L.S., F.Z.S., F.R.G.S., Sherwood Scrubs, Parramatta.
1886		Holmes, Spencer Harrison, "The Wilderness," Allandale, Hunter River.
1879		Houison, Andrew, B.A., M.B., C.M., *Edin.*, 128, Phillip-street.
1886		Hozier, Charles H. S., F.R.C.S., Irel., L.K. and Q.C.P., Irel., Windsor, N.S.W.
1877		Hume, J. K., "Beulah," Campbelltown.
1878		†Hunt, Robert, F.G.S., Deputy Master of the Royal Mint, Sydney, *Hon. Treasurer.*
1882		Hurst, George, M.B., Univ. *Lond.*, Mast. Surg. Univ. *Edin.*, 28, College-street, Hyde Park.
1886		Hutchinson, W. A., Bond-street.
1879		Inglis, The Hon. James, M.L.A., "Craigo," Redmyre.

Elected.		
1878		Jackson, Arthur Levett, Government Printing Office.
1876		Jackson, Henry Willan, M.R.C.S. *Eng.*, Lic. R. C. Phys., *Edin.*, 146, Phillip-street.
1885		Jackson, Rev. H. L., M.A. (Cantab.), St. James's Parsonage, Macquarie-street.
1879		Jefferis, Rev. James, LL.D., "The Retreat," Newtown.
1884		Jenkins, Edward Johnstone, M.A., M.D., *Oxon*, M.R.C.P., M.R.C.S., L.S.A., *Lond.*, Macquarie-street North
1879		Johnson, James W., "Brooksby," Double Bay.
1876		Jones, James Aberdeen, Lic. R.C. Phys. *Edin.*, Booth-street, Balmain.
1876		Jones, Richard Theophilus, M.D. *Sydn.*, L.R.C.P. *Edin.*, "Caer Idris," Ashfield.
1867		Jones, P. Sydney, M.D. *Lond.*, F.R.C.S. *Eng.*, College-street.
1877		Jones, Edward Lloyd, "Bickley," Burwood.
1874		Jones, James, "Miltonia," Randwick.
1879		Jones, John Trevor, C.E., "Tremayne," North Shore.
1884		Jones, Llewellyn Chas. Russell, 33, Castlereagh-street.
1863		Josephson, Joshua Frey, F.G.S., Bellevue Hill, Double Bay.
1876	P 2	Josephson, J. P., Assoc. Mem. Inst. C.E., George-street, Marrickville.
1878		Joubert, Numa, Hunter's Hill.
1883		Kater, H. E., "Mount Broughton," Moss Vale.
1873		Keele, Thos. Wm., Harbours and Rivers Department, Phillip-street.
1877		Keep, John, "Broughton Hall," Leichhardt.
1884		Kendall, Theodore M., B.A., F.R.C.S., F.R.C.P., F.M., 36, College-street, Hyde Park.
1874		King, Hon. Philip G., M.L.C., "Banksia," William-street, Double Bay.
1878		Knaggs, Saml. T., M.D., *Aberdeen*, 16, College-street.
1881	P 1	Knibbs, G. H., Trig. Branch, Surveyor-General's Office.
1874		Knox, George, M.A., *Cantab.*, Phillip-street.
1875		Knox, Edward, The Hon., M.L.C., O'Connell-street.
1877		Knox, Edward W., "Rona," Bellevue Hill, Double Bay.
1877		Kopsch, G., 8, Boulevard, Petersham.
1878		†Kyngdon, F. B., F.R.M.S. *Lond.*, 69, Darlinghurst Road, *Hon. Secretary*.
1878		Kyngdon, Fred. H., M.D. *Aberdeen*; L.S.A., *L.*; M.R.C.S., *E.*; C.M., *Aberdeen*, "Bon Accord," North Shore.
1884		Kyngdon, Boughton, L.S.A., Medl. Assoc. King's Coll. *Lond.*, 69, Darlinghurst Road.
1884		Lackey, The Hon. John, M.L.C., Warrigal Club.
1883		Lane, William H. H., 6, Bligh-street.
1874	P 1	Latta, G. J., "Mountsea," Burlington Road, Homebush.
1876		Laure, Louis Thos., M.D. Surg. Univ. *Paris*, 138, Castlereagh-street.

Elected.		
1859	P 6	†Leibius, Adolph, Ph.D., Heidelberg, M.A., F.C.S.; Senior Assayer to the Sydney Branch of the Royal Mint, *Vice-President*.
1885		Leverrier, Frank, B.A., B.Sc., "Tarnagulla," Waverley.
1874		Lenehan, Henry Alfred, Sydney Observatory.
1883		Lingen, J. T., M.A. *Cantab.*, 101, Elizabeth-street.
1883		Little, Wm., L.R.C.P., L.R.C.S. *Edin.*, Burwood.
1872	P 29	†Liversidge, Archibald, F.R.S.; Assoc. Roy. Sch. Mines, *Lond.*; F.C.S.; Fel. Inst. Chemistry of Gt. Brit. and Irl.; F.G.S.; F.L.S.; F.R.G.S.; Mem. Phy. Soc. London; Mem. Mineralogical Soc. Gt. Brit. and Irel.; Cor. Mem. Roy. Soc. Tas.; Cor. Mem. Senckenberg Institute, Frankfurt: Cor. Mem. Soc. d'Acclimat. Mauritius; Hon. Fel. Roy. Hist. Soc. Lond.; Mem. Min. Soc. of France; Professor of Chemistry and Mineralogy in the University of Sydney, *President*. The University, Glebe.
1874		Lloyd, The Hon. George Alfred, M.L.C., F.R.G.S., "Scottforth," Elizabeth Bay.
1881		Lloyd, Lancelot T., "Eurotah," William-street East.
1876		Lord, The Hon. Francis, M.L.C., North Shore.
1882		Lovell, R. Haynes, M.R.C.S., L.R.C.P., *Lond.*, 26, Wynyard Sq.
1878		Low, Hamilton, H.M. Customs.
1880		Low, Andrew S., "Merrylands," Granville.
1881		Lowe, Edwin, Wilgar Downs Station, *via* Girilambone.
1886		MacDonald, John A., Roads Department, Public Works, Sydney.
1884		MacCormick Alexr., M.D., M.B., Ch.M. *Edin.*, M.R.C.S.E., Demonstrator of Anatomy, University of Sydney, 205, Macquarie-street North.
1876		M'Culloch, A. H., jun., M.L.A., 121, Pitt-street.
1874		M'Cutcheon, John Warner, Assayer to the Sydney Branch of the Royal Mint.
1878		MacDonald, Ebenezer, "Elstow," Darling Point.
1868		MacDonnell, William J., F.R.A.S., Bank of New South Wales, Port Macquarie.
1877		MacDonnell, Samuel, 312, George-street, Sydney.
1886		MacFarlane, Edward, District Surveyor, Australian Club.
1882		MacGillivray, P. H., M.A., M.R.C.S., F.L.S., Sandhurst, Victoria.
1876		M'Kay, Dr., Belmont House, Wynyard Square.
1880	P 1	M'Kinney, Hugh G., M.E., Mem. Inst. C.E., Athenæum Club, Castlereagh-street.
1876		MacLaurin, Henry Norman, M.A., M.D. Univ. *Edin.*, Lic. R. Coll. Sur. *Edin.*, No. 155, Macquarie-street.
1872		Mackenzie, John, F.G.S., Examiner of Coal Fields, Newcastle.
1876		Mackenzie, Rev. P. F., "Sydenham," Reserve-street, North Annandale.
1880		Mackenzie, R. M., Bond-street.
1876		†Mackellar, The Hon. Chas. Kinnard, M.L.C., A.M., M.B., C.M., *Glas.*, Macquarie-street.
1882	P 1	Madsen, Hans. F., "Hesselmed" House, Queen-street, Newtown.
1885		Maher, W. Odillo, M.D., Queen's Univ. *Irel.*, 20, College-street, Hyde Park.

Elected.		
1883		Maiden, Josh. Hy., F.R.G.S., Technological Museum, Sydney.
1878		Maitland, Duncan Mearns, "Afreba," Stanmore Road.
1873		Makin, G. E., Berrima.
1880		Manfred, Edmund C., Montague-street, Goulburn.
1877		Mann, John F., "Kerepunu," Neutral Bay.
1881		Manning, Sir W. M., LL.D., Primary Judge, "Walleroy," Edgecliff Road, Woollahra.
1873	P 6	Manning, James, "Victis," Double Bay.
1876		Manning, Frederic Norton, M.D. Univ. *St. And.*, M.R.C.S. *Eng.*, Lic. Soc. Apoth. *Lond.*, Hunter's Hill.
1869		Mansfield, G.A., 121, Pitt-street.
1880		Marano, G. V., M.D. Univ. *Naples*, Clarendon Terrace, Elizabeth-street.
1878		Markey, James, L.R.C.S., *Irel.*, L.R.C. Phys., *Edin.*, Regent-street, Redfern.
1885		Marks, James Surfleet, The City Bank, Sydney.
1872		Marsden, The Right Rev. Dr.
1876		Marshall, George, M.D. Univ. *Glas.*, Lic. R. Coll. S. *Edin.*, Lyons' Terrace.
1886		Marshall. George A., M.B., 241 Elizabeth-street.
1886		Martin, Thomas M., L.R.C.P., L.R.C.S., *Edin.*, 241 Elizabeth-street.
1879		Masters, Edward, "Lurlei," Marrickville.
1875		Mathews, R. H., J.P., L.S., Singleton.
1879		Matthews, Robert, Tumut-street, Adelong.
1873		Milford, F., M.D. *Heidelberg*, M.R.C.S. *Eng.*, 3, Clarendon Terrace, Hyde Park.
1876		Millard, Rev. Henry Shaw, Newcastle Grammar School.
1885		Miller, Wm. Valentine, C.E., Bach. Eng. Q.U.I., "Bohrhurst," Timaru, New Zealand.
1884		Mills, Walter Wallace, East-street, Marrickville.
1882		Milson, Alfred G., "Coreena," East St. Leonards.
1882		Milson, James, "Elamang," North Shore.
1875		Moir, James, 58, Margaret-street.
1875		Montefiore, E. L., Darlinghurst.
1850	P 5	†Moore, Charles, F.L.S., Director of the Botanic Gardens, Botanic Gardens.
1879		Moore, Fred. H., Exchange Buildings, Pitt-street.
1886		Morgan, Dr. Edward H., Imperial Hotel, Mount Victoria.
1883		Morley, Frederick, 47, Surry-street, Darlinghurst.
1865	P 1	Morrell, G. A., C.E., 156, Pitt-street.
1877	P 1	Morris, William, Fel. Fac. Phys. and Surg. *Glas.*, F.R.M.S. *Lond.*
1880		Moses, David, J.P., Tenterfield.
1882		Moss, Sydney, 5, Hunter-street.
1879		Mountain, Adrian C., City Surveyor, Town Hall, Melbourne.
1877		‡Mullens, Josiah, F.R.G.S., Eldon Chambers, Pitt-street.
1879		Mullins, John Francis Lane, M.A., 2 Macleay Heights, Potts's Point.
1885		Munro, A. Watson, M.B., C.M., 131, Macquarie-street North.
1865		Murnin, M. E., "Eisenfels," Nattai.
1876		‡Murray, W. G., 93, Pitt-street.
1876		Myles, Chas. Henry, "Dingadee," Burwood.

Elected.		
1873		Neill, William, City Bank, Pitt-street.
1874		Neill, A. L. P., City Bank, Pitt-street.
1885		Newbery, William, M.A. (Cantab.), "The Hermitage," South Head Road, Double Bay.
1886		Newmarch, Bernard J., L.R.C.P., *Lond.*, M.R.C.S.E., Bowral.
1882		Norrie, Andrew, M.D., Mast. Surg., *Aberdeen* Univ., 171, Liverpool-street, Hyde Park.
1873		Norton, James, Hon., M.L.C., solicitor, O'Connell-street.
1875		Nott, Thomas, M.D. *Aberdeen*, M.R.C.S. *Eng.*, Ocean-street, Woollahra.
1878		Nowlan, John, "Eelah," West Maitland.
1879		O'Connor, Dr. Maurice, 26, College-street, Hyde Park.
1878		Ogilvy, James L., Commercial Bank of Australia, Pitt-street, Sydney.
1883		Oram, Arthur Murray, M.D., Univ. *Edin.*, 1, Hyde Park Terrace, Liverpool-street.
1875		O'Reilly, W. W. J., M.D., M.C., Q. Univ. *Irel.*, M.R.C.S., *Eng.*, Liverpool-street.
1882		O'Reilly, Rev. Alexr. Innes, B.A., *Cantab.*, Hayfield, Parramatta.
1883		Osborne, Benjn. M., J.P., Berrima.
1880		Paling, W. H., 356, George-street.
1875		Palmer, J. H., Legislative Assembly.
1880		Palmer, Joseph, 133, Pitt-street.
1882	P 1	Palmer, Edward (M.L.A., Queensland), c/o Messrs. B. D. Morehead & Co., Brisbane.
1885		Park, Archd. John, Chairman, Local Land Board, Hay.
1876		Parrott, Major Thomas S., C.E., 56, Arcade, King-street.
1878		Paterson, Hugh, 229, Macquarie-street.
1877		Paterson, James A., Union Bank, Pitt-street.
1878		Paterson, Alexander, M.D., M.A., "Hillcrest," Stanmore Road.
1877		†Pedley, Perceval R., 201, Macquarie-street.
1884		Perdriau, Stephen E., Lugar-street, Waverley.
1877		Perkins, Henry A., "Barangah," Homebush.
1881		Philip, Alexr., L.K. and Q.C.P., *Irel.*, L.R.C.S., *Irel.*, 540, Park View Terrace, Crown-street, Surry Hills.
1876		Pickburn, Thomas, M.D. *Aberdeen*, Ch. M., M.R.C.S. *Eng.*, 40, College-street.
1879		Pittman, Edwd. Fisher, L.S., Department of Mines, Sydney.
1881		Poate, Frederic, Government Surveyor, Summer Hill.
1879		Pockley, Thos. F. G., Commercial Bank, Singleton.
1882	P 1	Porter, Donald, Tamworth.
1878		Potts, F. H., "Hydebrae," Coventry Road, Homebush.
1886		Provis, John, 28, Charlotte Place.

Elected.		
1876		Quaife, Fredk. Harrison, M.D., Mast. Surg. Univ. *Glas.*, "Hughenden," Queen-street, Woollahra.
1886		Quaife, Wm. Francis, B.A., M.B., Ch. M., 30, Waverley Road, Woollahra.
1886		Quayle, Edwin, "Birkdale," Mansfield-street, Glebe Point.
1876		Quodling, W. H., "Couranga," Redmyre Boulevard, Strathfield.
1865	P 1	‡Ramsay, Edward, LL.D. (Univ. *St. And.*), F.L.S., Curator of the Australian Museum, College-street.
1876		‡Ratte, A. Felix, "Ingen. Arts et Manuf." Paris, "Officier d'Acad." Paris, Australian Museum, Sydney.
1874		Read, Reginald Bligh, M.R.C.S., *Eng.*, Coogee.
1868		Reading, E., Mem. Odont. Soc. *Lond.*, Elizabeth-street, Hyde Park.
1886		Redfearn, William, Conder-street, Burwood.
1881		Reid, William, Australian Joint Stock Bank, Sydney.
1881	P 3	Rennie, Edwd, H., M.A. *Syd.*, D.Sc. *Lond.*, Professor of Chemistry, University, Adelaide.
1870		Renwick, Arthur, B.A. *Sydn.*, M.D. *Edin.*, F.R.C.S., *Edin.*, M.L.A., 295, Elizabeth-street.
1880		Riddell, C. E., Union Club.
1886		Rigg, Thomas S. J., B.A., *Syd.*, Secretary's Branch, General Post Office, Sydney.
1856		Roberts, J., 340, George-street.
1868	P 3	Roberts, Sir Alfred, M.R.C.S. *Eng.*, Hon. Mem. Zool. and Bot. Soc. *Vienna*, 265 Macquarie-street North.
1881		Roberts, The Hon. C. J., C.M.G., M.L.A., "Chatsworth," Potts's Point.
1871		Robertson, Thomas, solicitor, 85, Pitt-street.
1856	P 8	†Rolleston, Christopher, C.M.G., Palmer-street, St. Leonards East, *President*.
1885		Rolleston, John C., C.E., "Northcliff," Milson's Point.
1865		Ross, J. Grafton, O'Connell-street.
1884		Ross. Chisholm, M.B., C.M., Hospital for the Insane, Gladesville.
1885		Ross, Elsey Fairfax, M.D. *Brux.*, 145, Macquarie-street North.
1885		Roth, Reuter Emerich, M.R.C.S. *Eng.*, 42, College-street, Hyde Park.
1882		Rothe, W. H., Union Club.
1876		Rowling, Dr., Chas., Parramatta.
1864	P 34	†Russell, Henry C., B.A. *Syd.*, F.R.S., F.R.A.S., F.M.S., Hon. Mem. S. Aust. Inst., Government Astronomer, Sydney Observatory, *Vice President*.
1886		Sager, Edmund E., Secretary to the Board of Health, 127 Macquarie-street.
1875		Sahl, Charles L., German Consul, Consulate of the German Empire, Wynyard Square.
1876		Saliniere, Rev. E. M., St. John's Parsonage, Glebe.
1884		Sands, Robert. 374, George-street.
1856	P 1	‡Scott, Rev. William, M.A. *Cantab.*, Hon. Mem. Roy. Soc. Vic., Kurrajong Heights.

Elected.		
1886		Scott, Walter, M.A., *Oxon.*, Professor of Classics, Sydney University.
1880		Scrivener, Charles Robert, Survey Department.
1876		Sedgwick, Wm. Gillett, M.R.C.S., *Eng.*, Newtown.
1877		Selfe, Norman, C.E., M.I.C.E., "Rockleigh," Balmain.
1876		Sharp, James Burleigh, J.P., Clifton Wood, Yass.
1876		Sharp, Henry, Green Hills, Adelong.
1878	P 1	Sharp, Revd. W. Hey, M.A. *Oxon.*, Warden of St. Paul's College, University.
1883	P 1	Shellshear, Walter, Assoc. M. Inst. C.E., "Trentham," Holt-street, Stanmore.
1879		Shepard, A. D., Shepard's Town.
1875		Sheppard, Rev. G., B.A., Berrima.
1882		Shewen, Alfred, M.B., M.D., Univ. *London*, M.R.C.S.E, 6, Lyons' Terrace, Hyde Park.
1882		Sinclair, Eric, M.B., C.M., Univ. *Glasgow*, Lunacy Dept., Gladesville Hospital for the Insane.
1883		Sinclair, Sutherland, Secretary, Australian Museum.
1884		Skirving, Robt. Scot, M.B., C.M., Elizabeth-street, Hyde Park.
1877		Slattery, Thomas, M.L.A., Premier Terrace, 169, William-street, Woolloomooloo.
1877		Sloper, Fredk. Evans, 360, Liverpool-street.
1881		Smedley, John, 263, George-street.
1875		Smith, Robt., M.A. *Syd.*, solicitor, O'Connell-street.
1874		‡Smith, John M'Garvie, Assayer, &c., Denison-street, Woollahra.
1878		Smith, E. E., "Clytie," 70, Darlinghurst Road.
1883		Smith, Robt. Burdett, M.L.A., 203, Macquarie-street North.
1884		Smith, Frede. Moore, M.D., M.R.C.S., Coast Hospital, Little Bay.
1886		Smith, Walter Alexander, A.M.I.C.E., Roads and Bridges Department, Newcastle.
1879		Spry, James Monsell, Union Club.
1881		‡Starkey, John Thos., 61½, Castlereagh-street.
1882		Steel, John, L.R.C.P., L.R.C.S., *Edin.*, 149 Elizabeth-street, Hyde Park.
1872	P 1	Stephen, George Milner, B.A., Mem. Geol. Soc. of Germany; Cor. Mem. Nat. Hist. Soc., *Dresden*; F.R.G.S. of *Cornwall.*
1879		‡Stephen, The Hon. Septimus A., M.L.C., South Kingston.
1879		Stephen, Alfred F. H., Audit Department, Bligh-street.
1857		Stephens, William John, M.A. *Oxon.*, Professor of Natural History in the University of Sydney, 71, Darlinghurst Road.
1883		Stephen, Cecil B., M.A., 101, Elizabeth-street.
1884		Strange, Fredk. R., Burwood.
1878		Street, John Rendell, M.L.A., "Birtley," Elizabeth Bay Road.
1876		Strong, Wm. Edmund, M.D., *Aberdeen*, M.R.C.S., *Eng.*, Government Medical Officer and Vaccinator for Sydney, 108 Phillip-street.
1876		Stuart, Clarendon, M.I.S., Cross-street, Double Bay.
1883		Stuart, T. P. Anderson, M.D., Univ. *Edin.*, Professor of Anatomy and Physiology in the University of Sydney.
1883		Styles, G. Mildinhall, Commercial Bank, George-street.
1884		Sunderland, Rev. J. P., 19, Wentworth Court, Elizabeth-street.
1876		Suttor, The Hon. Wm. Henry, M.L.C., "Cangoura," Bathurst.
1884		Syer, Frank Weston, 89, Pitt-street.

Elected.		
1879		Tarrant, Harman, M.R.C.S., 207, Macquarie-street.
1862	P 11	Tebbutt, John, F.R.A.S., Observatory, Windsor, N.S.W.
1879		Thomson, Dugald, care of R. Harper & Co., 409, George-street.
1875		Thompson, Joseph, "Trahlee," Bellevue Hill, Double Bay.
1877		Thompson, Thos. James, Eldon Chambers, Pitt-street, Sydney.
1885		†Thompson, John Ashburton, M.D. *Brux.*, Health Department, Sydney.
1878		Thomas, F. J., Hunter River, N.S.N. Co., Sussex-street.
1882		Thornton, Hon. George, M.L.C., 377, George-street.
1886	P 1	Threlfall, Richard, B.A., *Cantab.*, Professor of Physics, University of Sydney.
1876		Tibbits, Walter Hugh, M.R.C.S. *Eng.*, Manly.
1876		Toohey, J. T., "Moira," Burwood.
1884		Townsend, G. W,, C.E., Rooty Hill.
1882		Traill, Mark W., L.R.C.P. *Lond.*, M.R.C.S.E., Burwood.
1873	P 1	Trebeck, Prosper N., 91 Pitt-street.
1879		Trebeck, P. C., 91 Pitt-street.
1883		Trebeck, T. B., M.A., *Syd.*, Univ., No. 4 Brighton Terrace, Prospect-street, Waverley.
1885		Trickett, W. J., M.L.A., "Fairlight," Edgecliff Road, Woollahra.
1876		Trouton, F. H., Clifdale House, Balmain.
1877		‡Tucker, G. A., Ph. D., "Minnesota," Johnston-street, Annandale.
1868		Tucker, William, "Clifton," North Shore.
1875		Tulloh, W. H., "Airlee," Greenwich Point Road, North Shore.
1883		Tuxen, Peter Wilhelm, L.S., Survey Office, Sydney.
1882		Twynam, George Edwd., L.R.C.P. *Lond.*, M.R.C.S.E., 211 Macquarie-street North.
1883		Vause, Arthur J., M.B., C.M., *Edin.*, Bay View House, Tempe.
1884		Verde, Felice, 16, Prione Spezia, Italy.
1885		Vernon, Walter N., M.S.A., "Clytha" House, Neutral Bay, St. Leonards.
1876		Voss, Houlton H., J.P., Goulburn.
1879		Walker, H. O., Australian General Assurance Co., 97, Pitt-street.
1867		Walker, Philip B., Telegraph Office, George-street.
1867		Ward, R. D., M.R.C.S. *Eng.*, North Shore.
1883		Wardell, W. W., Fellow Royal Institute of British Architects, Lond., Member Institute Civil Engineers, Lond., "Upton Grange," St. Leonards.
1877		Warren, William Edward, M.D. and M.Ch., Queen's Univ. *Irel.*, 243, Elizabeth street, Sydney.
1883	P 1	Warren, W. H., M.I.C.E., Professor of Engineering, University of Sydney, "Madeley," Lordon-street, Enmore.
1876		Watkins, John Leo, B.A. *Cantab.*, M.A. *Syd.*, 105, Elizabeth-street.
1876		Waterhouse, J., M.A., *Syd.*, "Sauchie House," Church-street, West Maitland.
1876		Watson, C. Russell, M.R.C.S., *Eng.*, "Morevale," Newtown.
1877		Watt, Alfred Joseph, 528, George-street.

Elected.		
1859		**Watt, Charles, Parramatta.**
1876		Waugh, Isaac, M.B., M.C., *T.C.D.*, Parramatta.
1876		Webster, A. S., Gresham Chambers.
1867		Weigall, Albert Bythesea, B.A. *Oxon.*, M.A. *Syd.*, Head Master of the Sydney Grammar School, College-street.
1881		‡Wesley, W. H.
1878		Westgarth, G. C., solicitor, "Tresco," Elizabeth Bay.
1877		Weston, W. J., 5, Spring-street.
1879		‡Whitfeld, Lewis, M.A. *Sydney*, Judges' Chambers, Supreme Court.
1874		White, Rev. James S., M.A., LL.D., *Syd.*, "Gowrie," Singleton.
1875		White, Hon. James, M.L.C., "Cranbrook," Double Bay.
1877		‡White, Rev. W. Moore, A.M., LL.D., T.C.D.
1883		Whitelegge, Thomas, Australian Museum, College-street.
1884		Wiesener, T. F., 334, George-street.
1874	P 1	†Wilkinson, C. S., F.G.S., F.L.S., Government Geologist, Department of Mines.
1880		Wilkinson, Robt. Bliss, M.L.A., 12, Spring-street.
1878		Wilkinson, Rev. Samuel, Regent House, Regent-street, Petersham.
1883		Wilkinson, W. Camac, M.D., M.R.C.P. *Lond.*, M.R.C.S.E., M.L.A., "Hereford House," Glebe Point Road.
1876		Williams, Percy Edward, Treasury, Sydney.
1884		Williamson, Willm. Cotter, M.D., Hospital for the Insane, Parramatta.
1879		Wilshire, F. R., P.M., Berrima.
1878		Wilshire, James Thompson, J.P., "Havilah," Burwood.
1879		Wilson, F. A. A., Mercantile Bank, Sydney.
1876		Windeyer, W. C., M.A., *Syd.*, Puisne Judge, King-street.
1878		Wise, Henry, Savings' Bank of N.S.W., Barrack-street.
1873		Wood, Harrie, J.P., Under Secretary for Mines, Department of Mines.
1884	P 1	Wood, Arthur Pepys, C.E., Sydney Club.
1879		Woodhouse, E. B., "Mount Gilead," Campbelltown.
1876		Woolrych, F. B. W., 11, Hill-street, Newtown.
1886		Worrall, Ralph, M.D., C.M., Queen's Univ. *Irel.*, 34, College-street.
1881		Wright, Frederic, M.P.S., Harnett-street
1872		†Wright, Horatio G. A., M.R.C.S., *Eng.*, Wynyard Square
1884		Yeomans, Allan, Gilgoin, *viâ* Byrock.
1879		Young, John, Young's Buildings, corner of Pitt & Park Streets.

Honorary Members.

Limited to Twenty.

M. recipients of the Clarke Medal.

1875	Agnew, Dr., Hon. Secretary, Royal Society of Tasmania, Hobart.
1884	Airy, Sir George Biddell, K.C.B., M.A., D.C.L., *Oxon.*, LL.D., *Cantab. et Edin.*, F.R.S., &c., The White House, Croom's Hill, Greenwich Park, S.E.

Elected		
1875		Bernays, Lewis A., F.L.S., F.R.G.S., Brisbane.
1876	P 1	Cockle, His Honor Sir James, late Chief Justice of Queensland, M.A., F.R.S., Ealing, London.
1876	M	De Köninck, Prof., L.G., M.D., Liège, Belgium.
1875		Ellery, Robert F., F.R.S., F.R.A.S., Government Astronomer of Victoria, Melbourne.
1875		Gregory, The Hon. Augustus Charles, C.M.G., M.L.C., F.R.G.S., Geological Surveyor, Brisbane.
1875		Haast, Sir Julius von, K.C.M.G., Ph. D., F.R.S., F.G.S., Professor of Geology, Canterbury College, and Director of the Canterbury Museum, Christchurch, New Zealand.
1875	P 1 M	Hector, James, C.M.G., M.D., F.R.S., Director of the Colonial Museum and Geological Survey of New Zealand, Wellington.
1880	M	Hooker, Sir Joseph Dalton, K.C.S.I., M.D., C.B., F.R.S., &c., Director of the Royal Gardens, Kew.
1879	M	Huxley, Professor, F.R.S., LL.D., F.G.S., F.Z.S., F.L.S., &c., &c., Professor of Natural History in the Royal School of Mines, South Kensington, London.
1875	M	M'Coy, Frederick, C.M.G., D.Sc., F.R.S., F.G.S., Hon. F.C.P.S., C.M.Z.S., Professor of Natural Science in the Melbourne University, Government Palæontologist, and Director of the National Museum, Melbourne.
1875	P 4 M	Mueller, Baron Ferdinand von, K.C.M.G., M.D., Ph.D., F.R.S., F.L.S., Government Botanist, Melbourne.
1879	M	Owen, Professor Sir R., K.C.B., M.D., D.C.L., LL.D., F.L.S., F.G.S., V.P.Z.S., &c., &c., The British Museum, London, W.C.
1883		Pasteur, Louis, M.D, Paris.
1875		Schomburgh, Dr., Director of the Botanic Gardens, Adelaide, South Australia.
1884		Tyndall, John, D.C.L., *Oxon.*, LL.D., *Cantab*, F.R.S., F.G.S., &c., Professor of Natural Philosophy in the Royal Institution, Albemarle-street, London.
1875		Waterhouse, F. G., F.G.S., C.M.Z.S., Adelaide, South Australia.
1875	P 14	Woods, Rev. Julian E. Tenison-, F.G.S., F.L.S., Hon. Mem. Roy. Soc., Victoria, Hon. Mem. Roy. Soc., Tasmania, Hon. Mem. Adelaide Phil. Soc., Hon. Mem. New Zealand Institute, Hon. Mem. Linnean Soc., N.S.W., &c., Union Club, Sydney.

Corresponding Members.

Limited to Twenty-five.

1810	P 1	Clarke, Hyde, V.P. Anthropological Institute, 32, St. George's Square, London, S.W.
1879	P 3	Etheridge, Robert, junr., F.G.S., &c., The British Museum.
1883	P 1	Feistmantel, Ottokar, M.D., Bohemian Polytechnic High School, Prague, Austria.
1886		Marcou, Professor Jules, F.G.S., Cambridge, Mass., United States of America.
1880	P 1	Miller, F. B., F.C.S., Melbourne Mint.
1880	P 1	Ward, Sir Edward, K.C.M.G., Major-General, R.E., Cannes, France.

Obituary, 1886.

Ordinary Members.

Elected	
1878	Bestic, Dr. E. H.
1868	Brereton, Dr. J. Le Gay.
1876	Brodribb, Hon. W. A., M.L.C.
1876	Chandler, Alfred.
1878	George, Hugh.
1881	Goergs, Karl W.
1879	Jarvie, Rev. A. Milne.
1874	Mackenzie, Dr. W. F.
1878	MacPherson, Rev. Peter, M.A.
1876	Schuette, Dr. Rudolph.
1874	Stuart, Hon. Sir Alexander, M.L.A.
1870	Thompson, H. A.

AWARDS of the CLARKE MEDAL.

Established in memory of

The late Revd. W. B. CLARKE, M.A., F.R.S., F.G.S., &c.,

Vice-President from 1866 *to* 1878.

To be awarded from time to time for meritorious contributions to the Geology, Mineralogy, or Natural History of Australia, to men of science, whether resident in Australia or elsewhere.

1878. Professor Sir Richard Owen, K.C.B., F.R.S., Hampton Court.

1879. Mr. George Bentham, C.M.G., F.R.S., The Royal Gardens, Kew.

1880. Professor Huxley, F.R.S., The Royal School of Mines, London.

1881. Professor F. M'Coy, F.R.S., F.G.S., The University of Melbourne.

1882. Professor James Dwight Dana, LL.D., Yale College, New Haven, Conn., United States of America.

1883. Baron Ferdinand von Mueller, K.C.M.G., M.D., Ph.D., F.R.S., F.L.S., Government Botanist, Melbourne.

1884. Alfred R. C. Selwyn, LL.D., F.R.S., F.G.S., Director of the Geological and Natural History Survey of Canada, Ottawa.

1885. Sir Joseph Dalton Hooker, K.C.S.I., C.M., M.D., D.C.L., LL.D., &c., Director of the Royal Gardens, Kew.

1886. Professor L. G. De Koninck, M.D., University of Liege, Belgium.

1887. James Hector, C.M.G., M.D., F.R.S., Director of the Geological Survey of New Zealand, Wellington, N.Z.

NOTICE.

Members are particularly requested to communicate any change of address to the Hon. Secretaries, for which purpose this slip is inserted.

Corrected Address.

Name .....

.....

Titles, &c. .. ....

.....

Address .....

.....

Date.....

To the

Hon. Secretaries,

The Royal Society of N.S.W.,

37, Elizabeth-st., Sydney.

PRESIDENT'S ADDRESS.

By Professor Liversidge, F.R.S., &c.

[*Delivered to the Royal Society of N.S.W., 5 May, 1886.*]

On this the 65th anniversary of the foundation of the Royal Society of New South Wales, it devolves upon me to address you, and to thus continue what has hitherto been the annual custom since the first formation of the Society. It is true that there have been breaks, but the years in which they have occurred are few and far between. For many reasons I should have been glad to have been relieved, but I am afraid that it would have appeared like shirking the duties and responsibilities of the high office to which you elected me, after having enjoyed the honors of the position.

It has been more than once suggested by previous Presidents that the custom should be discontinued, since the Council has often failed to secure the services of competent members to fill the Presidential Chair, simply on account of their inability to find time to prepare the expected annual address. For my own part, I can thoroughly sympathize with them; and as a compromise between the usual address upon scientific matters to which you have hitherto been accustomed, and none at all, I venture to bring before you a few remarks upon certain matters which may perhaps be not altogether devoid of interest to you, inasmuch as, with one or two exceptions, they may be regarded as belonging more or less completely to the domestic affairs of the Society.

In the first instance, it is my melancholy duty to place on record a brief notice of such of our members as have been removed from our midst during the past year.

At the meeting held in November last we expressed our grief for the loss we had sustained in the removal of the late Hon. Prof.

John Smith, C.M.G., M.L.C., LL.D., M.D., our former President, our appreciation of his life and labours, and our heartfelt sympathy with his widow in her great bereavement.

It is, however, only fitting that I should give a somewhat fuller account of the work which he did for us and for the public at large, and especially, as I said on that occasion, since but very few appear to know how much the Colony is indebted to him. Quiet, unobtrusive, conscientious workers, such as he, especially when they are unpaid for their self-imposed and philanthropic labours, seldom receive during their lifetime a just recognition of their deserts, and not always after their death.

Professor Smith was born in Scotland, about the year 1821, and was educated at Marischal College, in the University of Aberdeen, where he took the degrees of M.A. and M.D. After taking his degrees, he for some five years carried on the chemistry class in Marischal College during the illness of Prof. Clarke.

When the University of Sydney was endowed and incorporated, a Committee was appointed in London, consisting of Sir John Herschel, F.R.S., Bart., Sir George Airey, Astronomer Royal, Prof. Malden, of University College, London, and others, to select Professors for the Chairs of classics and mathematics, and one for certain portions of science. This Committee made the three appointments in 1852, and Dr. Smith was selected as the first Professor of chemistry and experimental physics ; and he retained the latter portion of the original Chair from the time of his arrival in October, 1852, until his death in October, 1885. In addition, he was for many years Dean of the Faculty of Medicine. He was a Fellow of the Chemical Society of London, and an honorary member of the Royal Society of Victoria.

Soon after landing here, in 1853, he was appointed to the Board of National Education, and remained one of its most prominent and useful members until 1866, when the Board was superseded by the Council of Education, constituted under the Public Schools Act, to which he was gazetted as one of the first members, and of which he was nine times elected President. During his period of

office Prof. Smith took the opportunity to effect many improvements, and the Colony is indebted to him for several of the best features of the present system of Education.

He devoted himself to the work, and undertook duties of a most laborious character—he was in fact during this period the chief administrative officer of the Educational system of the Colony. The old officials under the late Board of Education all unite in bearing testimony to this, in speaking in terms of regret for the loss of their late President, of his many good qualities and great consideration for those under him—as one of them states, he was "the last to censure but the first to forgive"—and of the great indebtedness of the Colony to his labours.

He spent years of self-sacrificing toil without emolument and without hope of reward. The work was done so quietly and unobtrusively that he could not have been actuated either by hope of praise nor of social distinction, the motive being a real love for the work and of his fellows.

One or more afternoons and most of his evenings in each week were spent at the offices of the Council, transacting its business and arranging for future action. He in fact performed gratuitously the work which would have devolved upon the Minister for Public Instruction had one then existed.

As a mark of the value set on his business qualities, it may not be out of place here to mention that in 1864 Dr. Smith was chosen a Director of the Australian Mutual Provident Society, and was for many years its Chairman.

In 1867 he was President of the Royal Commission appointed to inquire into the supply of Water to Sydney and its Suburbs. From his position he necessarily had much to do with the direction and methods of investigation followed, and especially in the scientific questions relating to the sources of the water supply, and the collection and chemical examination of the samples.

The labours of the Commission in examining witnesses, visiting the catchment areas, obtaining records of rainfall, flow of rivers,

preparation of sections and other matters extended over some two years, and the work was not completed until 1869, in most of which he took a leading part. The scheme recommended by the Commission is practically that now being carried out by the Government.

He was elected a Member of the Legislative Council in 1877, and retained his seat until his death. He always showed great interest in his legislative duties, and often took a leading part in the debates, especially when they were connected with scientific or medical questions.

For some years he was a Trustee of the Australian Museum, but relinquished his connection with the Museum about 1870, on account of want of time.

He was appointed one of the Commissioners for carrying out the Sydney International Exhibition of 1879. Before this he had sat as a member of other similar Commissions. He was a member of the Commission for the New Zealand Exhibition in 1865, and for the Paris Exhibition in 1867. He was a member too of the Royal Commission upon the Sydney and Suburban Sewerage and Water Supply, which was appointed in 1875, and took an active part in its labours and investigations. In recognition of his public service in this Colony, his *alma mater*, the University of Aberdeen, made him an Honorary LL.D. in 1876, and in 1878 he was made a Companion of the Order of St. Michael and St. George.

Before settling in this Colony Dr. Smith had travelled extensively, having visited China, Java, the Polynesian Islands, Mauritius, India, Indian Archipelago, &c.; after his arrival he visited New Zealand and the other Australasian Colonies. He revisited Europe on three occasions, to keep himself abreast of the times; and on one of these journeys he travelled through America and the principal parts of Europe, and made a rather lengthened excursion through Egypt and the Holy Land.

On these trips he took occasion to visit the principal educational and scientific institutions, and to make the acquaintance of the leading scientific men; and on his return he always gavethe public the benefit of his gleanings, by lecture or in other ways.

Dr. Smith was one of the oldest members of our Society, he having joined it as far back as 1852, when it was known as the Australian Philosophical Society.

At a meeting presided over by Sir William Denison, the then Governor-General, held on May 9th, 1856, the Australian Philosophical Society was remodelled, and renamed the Philosophical Society of New South Wales, when Dr. Smith was appointed one of the Honorary Secretaries in recognition of the active part he had taken in bringing about the changes; he retained this position until 1860, and the earlier records in the minute books are in his handwriting.

He was a member of the Council for nine out of the eleven years during which the Society was known as the Philosophical Society, and during those years he read the following papers:—

August 13th, 1856.—"On the action of Sydney Water upon Lead."

November 16th, 1859.—"On the Separation of Gold from Mundic Quartz."

August 15th, 1860.—"On the Quartz Reefs of Upper Adelong."

November 11th, 1863.—"On ancient flint Implements found near Abbeville."

August 17th, 1864.—"On the probable reasons that led Fahrenheit to the adoption of his peculiar Thermometric Scale."

Afterwards, when the constitution was again reformed and the name changed to that of the Royal Society, he was retained as a member of the Council, which position he has held for eighteen years. During this time he filled the office of Vice-President for ten years, and he was twice elected to the Presidential Chair. Previous to 1879 the Governor for the time being was, *ex officio*, President, so that Dr. Smith, as senior Vice-President, was in reality performing the duties of President for several years.

The following papers were read by him betwen the years 1868 and 1884:—

14 Oct., 1868.—"On the Water Supply of Sydney."

17 Nov., 1869.—"On the results of the Chemical Examination of Waters for the Sydney Water Commission."

12 May, 1871.—"Anniversary Address."

3 Oct., 1877.—"On a System of Notation adapted to explaining to Students certain Electrical Operations."

28 May, 1879.—Anniversary Address.

4 May, 1881.—Anniversary Address.

7 May, 1884.—Anniversary Address.

He was a regular attendant at the Council meetings as well as at the general meetings, and did much in many ways for the promotion of the objects of the Society, its interests and welfare.

I repeat what I have already said on a previous occasion,—that only those who have worked with or who have otherwise been closely associated with our late Vice-President can fully appreciate and testify to his great honesty of purpose, impartiality, even disposition, tolerance, and uniform courtesy.

The regret of his friends and the respect in which he was generally held were shown at his funeral by the large gathering of all classes, and especially of his past students. Public bodies, such as the University, the Legislative Council, and other institutions with which he was connected, also expressed their appreciation of his long and meritorious services, by passing resolutions of condolence and sympathy with his widow in her bereavement.

As you are aware, it has been resolved by the Council to collect subscriptions for the purpose of providing a memorial for our late Vice-President, in the form of an oil painting, similar to that of the Rev. W. B. Clarke, a former Vice-President, and, if there be any surplus funds, to found a prize to be awarded from time to time for meritorious contributions to physical science. I am sorry to say, however, that the amount collected up to the present is quite insufficient for the latter purpose.

During the past year death has been unusually busy amongst our medical members. By the death of Dr. Fortescue, M.B., of London University, and Fellow of the Linnean Society of London, this community has lost one of its most prominent members of the medical profession, and the Society one of its most respected associates. Dr. Fortescue was twice a member of the Council, viz., in 1867, 1868, and he was three times elected a member of the Committee of the Medical Section; but being a busy man, he only found time to prepare one paper for the Section, viz., "Upon a series of Experiments on a normal Eye, with the watery extract of *Duboisia myoporoides*." He was for several years a Trustee of the Australian Museum, in which institution he took great interest. On account of his genial and kindly disposition he was a general favourite, and his loss is regretted by a wide circle of friends.

In Dr. T. Cecil Morgan we have lost another much respected member of the medical profession. Dr. Morgan joined the Society in 1876, and was a constant attendant at the meetings of the Medical Section; he was twice elected on to its Committee, he regularly took part in the discussions, on several occasions brought forward matters of interest, and twice communicated papers to it. Dr. Morgan was more particularly distinguished for his attainments and position here in respect to ophthalmic science.

I regret to have to record the deaths also of two of our younger members, in the persons of Dr. Arthur Annesley West, M.B., of Dublin University, and of Dr. George J. Renwick. The latter was a student of the University of Sydney, where he took his degree in Arts. He afterwards went home and studied medicine at Edinburgh, where he took the degrees of M.B. and C.M.

Dr. Renwick gave great promise of occupying a prominent position in his profession, and what would probably have been a distinguished career has been arrested by his premature death.

The Colony has sustained the loss of a valuable life and the Society of a much respected member by the death of Sir George Wigram Allen, K.C.M.G., the late Speaker of the Legislative Assembly. Sir G. Wigram Allen joined the Society some fifteen

years ago; his attention was not particularly drawn to matters with which the Society is interested, he being more closely identified with politics, but he devoted a good deal of time to educational matters. He was associated for fourteen years with the late Professor Smith as a member of the National Board for Education, for some years he was a Trustee of the Sydney Grammar School, a member of the University Senate, and he was the first Minister for Justice and Public Instruction. Although he never took an active part in the work of this Society, that he was willing to assist in the advancement of learning is shown by his founding a scholarship at the University for the encouragement of the study of legal science.

The Society has also lost by death two other members, in Mr. Douglas Helsham and Mr. William Wallis, the latter an old colonist, whose name deserves to be recorded as the contractor for the first railway in the Colony, and for the encouragement he gave to art.

I have the pleasure to congratulate you upon the very satisfactory state of the Society's affairs. It is true that the number of members has undergone a slight decrease, but the diminution is immaterial, and will doubtless be made up during the present year by the election of new members.

The number of members on the roll on April 30th, 1885, was 494; during the past year twenty-seven new members have been elected, and two names have been restored to the roll. Against this increase we have lost eight members by death, ten have left the Colony or resigned, ten names have been struck off the roll for non-payment of subscriptions, and three elections have been cancelled for the same reason, leaving on April 30th last an effective list of 492. In addition there are twenty honorary and five corresponding members.

As shown by the Hon. treasurer's balance sheet, our financial affairs are also in a very satisfactory state. It is true we have not a very large cash balance in hand, but that, I think, is what we should avoid. Once the Society had managed to save some £400,

mainly by leaving necessary matters undone, and it lived upon these savings of more energetic and prosperous days as long as they lasted, and as a consequence nearly died the ignominious death of a pauper. It is our duty to expend the funds entrusted to us wisely—certainly to the best of our ability—to promote the Society's objects, without wasteful extravagance, neither should we wrap them up idly in a napkin.

During the past year the Society's house has been much improved by the alterations and additions to the front of the building. After defraying the cost of the improvements, some £168, the Council is still in a position to pay off another £100 from the debt, so that the amount now owing upon the building is only £800. During the past year the special subscriptions to the building fund amounted to £35, and there remain promises to the extent of about £280, which were made in 1882 conditionally upon sufficient funds being obtained to clear off the debt; hence, if the members would at once subscribe another £250, we could, with the Government grant and entrance fees, entirely pay off the mortgage. Up to the present, out of our 492 members only about 160 have subscribed to the building fund. If the majority of the remaining 340 were to give only one pound each the debt would be extinguished. I do not think this is asking too much, for we have probably but few members who cannot afford this amount.

Closely connected with the question of funds is the fact that we ought to make efforts to publish our volume ourselves, and we shall hardly be in a position to do that until we are out of debt. We are deeply grateful to the Government for its assistance in this matter; but there is no doubt we suffer somewhat from the delay which necessarily arises in the appearance of the volume; we cannot, however, expect our printing to take precedence over that for the Parliament and Public Departments of the Colony.

For the past three or four years fairly considerable sums, for us, have been expended upon the library; special efforts have been made to render the collection of books as complete as

possible in scientific periodical literature, *i.e.*, in the Transactions, Journals, and similar publications of kindred Societies and Institutions. A poor Society such as this cannot, of course, hope to have a complete library in all classes of scientific books—we must content ourselves with some one department—and that chosen is the one less likely to be undertaken by other Libraries in the Colony. Most modern scientific books can be purchased at any time, and are purchased by the Free Public and other Libraries in Sydney, but the earlier volumes of the Transactions of Scientific Societies are not so likely to be purchased by them; they, too, are becoming more expensive and more difficult to obtain every day. Such publications are absolutely essential to all who are actively engaged in research of any kind. Unless the investigator can refer to what has already been done by others, much labour may be unnecessarily repeated and valuable time lost thereby.

We have now secured the principal series; in the future the expenditure upon such publications need not be so large, although many important sets have yet to be completed.

Many of our series have been completed by the generosity of the Societies which published them, and some of the presentations thus made at our solicitation are extremely valuable and important.

During the past year the Society has received 1,420 vols. and pamphlets as donations, amongst which the following call for special recognition :—

Faune du Calcaire Carbonifère de la Belgique. Vols. I–III 10 parts, 4to. Presented by the author, Professor De Koninck.

Reports of the Second Geological Survey of Pennsylvania. 76 vols. Presented by the Board of Commissioners.

Monographs and Reports published by the United States Geological Survey. 9 vols. 4to. Presented by the Director.

Transactions of the Connecticut Academy of Artsand Sciences, from the commencement in 1866 to 1885 complete. Presented by the Society.

Bulletin of the Société Minéralogique de France. Tomes 1 to 8 complete. From the Society.

Bulletin, vols. 1 to 4, and Mémoires vols. 1 and 2, 4to. of the Comité Géologique Institut des Mines, St. Petersburgh. Presented by the Committee.

Journal of Civil Engineers (4 series). Vols. 1 to 5, and atlases of drawings. Presented by the Minister of Public Instruction at Rome.

A large number of missing parts were presented by the Boston Society of Natural History, and the Johns Hopkins University, Baltimore, to make the sets of their various publications, now in the Society's Library, as complete as possible.

A complete set of Braithwaite's Retrospect of Medicine, vols. 1 to 92, from the commencement in 1840 to 1885, was generously presented by Dr. Chisholm Ross, of Gladesville.

The Society has presented its Journal and Proceedings vol. XVIII for 1884 to 326 kindred institutions, as per printed list, and it has likewise been distributed to all the members entitled to it. Vol. XIX is in type, and will soon be ready for distribution.

Since the last year the following new Societies have entered into an exchange of publications, viz. :—

Amsterdam, L'Association Coloniale Néerlandaise.
Denver, Colorado Scientific Society.
Edinburgh, Scottish Geographical Society.
Florence, Società Africana d'Italia (Sezione Fiorentina).
Leipzig, Königlich Sachsische Gesellschaft des Wissenschaften.
New York, New York Microscopical Society.
Philadelphia, Second Geological Survey of Pennsylvania.
Vienna, K. K. Naturhistorische Hofmuseum.

And the following Societies already on the list have commenced sending their publications, in exchange for ours, viz. :—

Adelaide, Public Library, Museum, and Art Gallery of South Australia.
Helsingfort, Société des Sciences de Finlande.
Liège, Société Royale des Sciences.
The Bureau of Ethnology, Washington.

The Society has subscribed to forty-eight scientific journals and periodicals, and has purchased 390 vols., at a cost of £260 14s. 5d., amongst the most important of which are the following complete series from the commencement :—

Annals of Natural History, Series 1, 2, 3, 4. 76 vols.
Catalogue of the Pathological Department, Royal College of Surgeons, 7 vols.
Medico-Chirurgical Society—Transactions, vols. 1, 64, 68.
Obstetrical Society—Transactions, vols. 1, 23, 24.
Pathological Society—Transactions, vols. 1, 32, 34.
Petermann's Mittheilungen Geographie, vols. 1, 25, 27.
Reports of the Medical Officer of the Local Board of Health, London, 1858–1883, 17 vols.
Scientific American (2nd series), vols. 1–39.
Zoological Society—Proceedings (coloured plates), 1830–1883, 55 vols.

During the past session the Society held eight meetings, at which the following papers were read, viz. :—

1885.

6 May. Presidential Address, by H. C. Russell, B.A., F.R.A.S.

3 June. Notes on Flying Machines, by Lawrence Hargrave.

,, On a System of Accurate Measurement by means of long steel Ribands, by G. H. Knibbs.

1 July. Local variations and vibrations of the Earth's surface, by H. C. Russell, B.A.,F.R.A.S.

5 Aug. Some causes of the decay of the Australian Forests, by Rev. Peter MacPherson, M.A.

2 Sept. The History of Floods in the Hawkesbury River, by J. P. Josephson, A.M.I.C.E.

7 Oct. The Ringal of the North-western Himalaya, by Dr. Brandis, F.R.S. (Communicated by Baron von Mueller, K.C.M.G.)

4 Nov. Notes on experiments in mounting the *Amphipleura pellucida* in media having a higher refractive index than Canada Balsam, by William Morris, Fel Fac. Phys. and Surg. Glas., F.R.M.S., Lond.

4 Nov. Notes on the characters of the Adelong Reefs, by S. Herbert Cox, F.C.S., F.G.S.

„ Stone Implements of the Aborigines of Australia and some other countries, by Rev. Peter MacPherson, M.A.

2 Dec. On a Form of Flying-machine, by Lawrence Hargrave.

„ On a New Form of Anemometer, by H. C. Russell, B.A., F.R.A.S.

The Medical Section held eight meetings, at which eighteen papers were read.

The Microscopical Section held eight meetings, and three papers were read by Dr. Morris, viz. :—

11 May. On *Phylloxera vastatrix.*

14 Sept. Notes on experiments with highly refractive media.

14 Dec. Method of mounting in sulphur and arsenic.

The Clarke Memorial Medal has been awarded for the year 1886 to Dr. L. G. De Koninck, M.D., the celebrated Belgian Geologist, formerly Professor in the University of Liège. A more deserving award could not have been made. It is not necessary to point out in detail the work which he has done for geology and palæontology. Professor De Koninck has been selected in recognition of his long continued scientific researches and numerous valuable publications upon geology and palæontology and distinguished scientific attainments, but more particularly on account of his splendid contributions to our knowledge of the palæontology of the carboniferous rocks of Europe, the geology of Belgium, and the palæozoic fossils of New South Wales. The award will probably be none the less acceptable to the recipient, inasmuch as I understand Professor De Koninck is an old friend, and certainly for long a coadjutor of the late Rev. W. B. Clarke.

It is a source of some regret that the Clarke Memorial Fund is as yet too small to permit us to proceed with the proposed Clarke Memorial Lectures. There has been a slight loss in interest by the suspension of the Bank in which the funds were deposited,

but it is expected that in time the whole of the capital will be repaid ; we then hope to be in a position to make a commencement, giving occasionally a short course of lectures upon geology, the science to which he was so much devoted.

According to established custom, I waited upon His Excellency the Governor, and I have the pleasure to inform you that Lord Carrington has expressed his willingness to accept office as our Honorary President, and to render every service to the Society, and promote its interests in any way which may be within his power.

As you will see from the ballot papers, we are about to lose the valuable services of Dr. Leibius, who for the past eleven years has been one of our Hon. Secretaries. When I state that we all regret that he finds it necessary to retire from the position which he has so honorably and efficiently filled for so many years, I feel that I am but imperfectly expressing the gratitude which the members entertain for the many services he has rendered to the Society, their appreciation of his great worth, and of the interest and care which he has always shown for the Society's welfare.

Personally I am probably better aware than most of you how much of his time he has given to its affairs. Not only has he been one of our Secretaries for so long, but previously to that he was for some years a Member of Council. I know that he has often devoted his leisure and evenings to the Society, at a great sacrifice to his own comfort and convenience. I need hardly remind you that his duties at our Council and general meetings absorbed but a small portion of the time which he has cheerfully placed at our disposal. I trust, and I am sure you will all join with me in expressing the hope, that he will long remain with us in a more honorable although less exacting position such as that for which he has been nominated.

It is a source of much regret and considerable concern that the number of original papers contributed to the Society is so small. Out of nearly 500 existing members, only thirty-five have contributed papers, and the majority of those have been supplied by

some seven or eight individuals. It is not from lack of subjects, for there are many questions which require investigation, but rather from the lack of competent investigators who can spare the necessary time. There are but few men of leisure in the Colonies, and still fewer of learned leisure.

Up to the present but little original work has been done in working out the chemistry of our mineral and vegetable products, and really but very little in many branches of biology. The descriptions, catalogues, lists, &c., of our flora and fauna are making fair progress, but still very little has been published relating to the development and life history of the fauna of Australia, even of forms of life peculiar to this part of the world.

In matters of natural history, geology, and allied subjects, it is apparent to every one that the materials for original work are, in New South Wales, thickly spread about us, and a considerable amount of very valuable work is being done in this direction by the Linnean Society of New South Wales, but the amount which is waiting to be done is far more than we can cope with at present.

There is probably a greater number of questions waiting to be solved in other branches of science, yet, from the circumstances naturally connected with a new country, it is not easy to make progress with their solution. Too often physical, chemical, and similar questions, not only involve long-continued labour for their investigation, but too often also bulky and expensive apparatus is required—not always to be obtained in new countries. Fortunately in certain branches of natural history this is not always the case, and, accordingly, much more work has been done in questions relating to the systematic sciences than to problems in the experimental ones; but few workers here have the advantage of even a poorly furnished physical or chemical laboratory, and no one of a first-class or well-appointed one—such does not at present exist in the Colony, although some improvements have of late years been effected in this direction at the University.

This Society is doing what it can to encourage original work, by offering its medal and money prize for the best original communications upon certain specified subjects; but the amount which we can spare for this out of our limited income is only £100 a year, and we are quite aware that the Society's medal and the sum of £25 will not repay any one for perhaps years of labour ; but it is hoped that the recognition which the award carries with it may serve as a slight additional stimulus, and help to promote the taste for original investigation.

Up to the present time we have had but few researches of sufficient merit to entitle us to make the award. I am, however, confident that good is being done, and I do not think we should lose heart; attention is directed to such matters, and doubtless work is being done, in response to our suggestions, of which we as yet know nothing. The writers of the many papers which failed to reach the required standard, although perhaps disappointed, have not suffered by the failure of their attempts, but on the contrary, have doubtless been much benefited by their efforts, and our stock of information upon those subjects will in the future probably owe much to their apparently disregarded work. We have had inquiries from scientific chemists in England and elsewhere for supplies of material, notably of the gums and resins, the so-called "kerosene shale," and of the iron and other ores of the Colony. Arrangements have been made in two cases to furnish a supply of the kerosene shale. I may perhaps here mention that attempts have been made, by repeated advertisements and otherwise, to obtain samples of the New South Wales gums and resins to supply those who wish to examine them, and for our Museums, but unsuccessfully up to the present; hence it might be thought that the Colony is not so rich in such products as is usually stated.

I regard this difficulty of obtaining samples of gums and resins, true to name, as an additional proof of the ignorance which exists with regard to the natural products of the Colony. It is quite certain that but little use is made of them. Of the large number of

gums, resins, tanning materials, and other similar products, almost the only ones made use of are grass-tree gum, eucalyptus oil, and wattle-bark.

If such questions as "The Chemistry of the Australian Gums and Resins," "The Tin Deposits of New South Wales," "The Iron Ores," and the "Silver Ores of New South Wales," &c., were thoroughly worked out, the results would doubtless be of great pecuniary value to the Colony; and their investigation is really a matter of great public importance, and accordingly I think this Society should not be left, with its limited funds, to deal with it single-handed; it is a work in which the Government might assist with propriety—special help in particular cases should be rendered to those who are willing to engage in such researches. The Imperial Government places the sum of £4,000 annually at the disposal of the Royal Society of London for the encouragement of scientific research, on the understanding, of course, that such assistance should not be used personally, but merely to defray the legitimate expenses of the work. Wealthy colonists who are not able to undertake such work themselves might, with great advantage to the State and credit to themselves, place funds at the disposal of the Council for encouraging original investigation.

Certain of the other English Societies, like the Chemical Society and the British Association, also expend considerable portions of their own funds in encouraging research by such grants. The former has a fund specially collected for the purpose.

No communications of sufficient merit were received during the past year to justify the award of the Society's Medal and prize. The Council has accordingly invited contributions upon the same subjects for the year 1888, so that the list of subjects for which it offers the Society's Medal and prize of £25, for communications containing the results of research or observation, is as follows:—

SERIES V.—**To be sent in not later than 1st May, 1886.**

No. 16.—On the Chemistry of the Australian Gums and Resins. **The Society's Medal and £25.**

17.—On the Tin Deposits of New South Wales. The Society's **Medal and £25.**

18.—On the Iron Ore Deposits of New South Wales. The Society's Medal and £25.

19.—List of the Marine Fauna of Port Jackson, with descriptive notes as to habits, distribution, &c. The Society's Medal and £25.

SERIES VI.—To be sent in not later than 1st May, 1887.

No. 20.—On the Silver Ore Deposits of New South Wales. The Society's Medal and £25.

21.—Origin and mode of occurrence of Gold-bearing Veins and of the associated Minerals. The Society's Medal and £25.

22.—Influences of the Australian Climate in producing modifications of Diseases. The Society's Medal and £25.

23.—On the Infusoria peculiar to Australia. The Society's Medal and £25.

SERIES VII.—To be sent in not later than 1st May, 1888.

No. 24.—Anatomy and Life History of the Echidna and Platypus. The Society's Medal and £25.

25.—Anatomy and Life History of Mollusca peculiar to Australia. The Society's Medal and £25.

26.—The chemical composition of the products from the so-called Kerosene Shale of New South Wales. The Society's Medal and £25.

This Society also tries to encourage scientific research by offering money grants under the usual conditions, but up to the present there have not been applicants for such assistance. This may be partly due to the offer not being sufficiently known, but in some instances would-be applicants have refrained from applying, since they feel that the Society cannot well afford to do more than it does in offering the £100 a year for special prizes.

The Microscopical Section has a wide field before it; and many of its members, who are not already contributors, have the necessary ability and appliances for doing some good original work, and I am confident that they could do much if they would only take up some definite line of investigation. I know that in some cases the non-production of papers is due to a feeling of diffidence; and an idea that such work can only be performed by those who have undergone a special training, but this is not

necessary, although of course it is highly desirable and very advantageous. Most of the advances and discoveries made in microscopy have been made by what may be termed amateurs. Even the preparation of lists of microscopic forms of "moulds," fungi, diatoms, desmids, &c., would be useful, and I would strongly urge every member who possesses a microscope to commence original work of some kind. He will be pleased and astonished to see how valuable facts will rapidly grow and accumulate under his hands.

I would also venture to suggest that such of the papers read before the Medical Section as are suitable should be published in the Society's volume. The others, if necessary, and thought desirable by the Section, might be printed separately and forwarded only to the members of the Medical Section.

One of the few facilities for scientific work which we possessed here and in which the Society assisted in founding, viz., the Biological Laboratory at Watson's Bay, has been closed. I regret to say that the Government has resumed the house and grounds for defence purposes. Up to the present the laboratory has not been so much used as was hoped and expected; this was probably due to its comparatively inaccessibility, and to its lack of fittings and appliances, especially for marine biology,—M. de M. Maclay, to whose exertions the formation of the laboratory was mainly due, having been, so far, the only worker who has made use of it. The Government will doubtless refund the trustees the cost of the building, and with that as a nucleus we may be able to start afresh. It would be a great pity to allow such an undertaking to drop here, especially as there is such an unlimited field for marine biological work before us in Australia.

In the course of years it is to be hoped that this scarcity of scientific workers in the Colony will gradually disappear with the spread of general and liberal education. By a liberal education I mean something more than ordinary course in Arts.

After a lapse of some thirty odd years from its foundation, the University had at last been able, by the greater liberality of Parliament, and by the receipt of private endowments, to make better

provision for instruction in science, although many of the arrangements are still of a very meagre and imperfect character, and more or less unworthy of the boasted greatness and richness of the "oldest and richest Australian Colony." The accommodation and appliances are by no means equal to those of many schools for boys at Home, on the Continent, and in America, and certainly **not to colleges in Japan.**

Of late we have been told by the newspapers that the University is richly endowed. This is very far from the case. If the income of the Sydney University be compared with that of other Universities (not Australasian, for none of these have yet been placed upon a proper footing), it will be seen that proportionately it is very poor, and in a more or less starved condition. To properly equip the University in all the various departments of science, literature, art, medicine, law, engineering &c., would require very **much more than its present income.**

In connection with the subject of the education of our future scientific investigators, perhaps I may be allowed to refer to some recent expressions of opinion on this. Professor Huxley, in his Presidential Address to the Royal Society in November last, in speaking of scientific education, says:—"There is no reason in the nature of things why the student who is destined for a scientific career should not in the first place go through a course of instruction such as would ensure him a real, that is to say, a practical acquaintance with the elements of each of the great divisions of mathematical and physical science; nor why this instruction in what (if I may borrow a phrase from medicine) I may call the institutes of science, should not be followed up by more special instruction, covering the whole field of that particular division in which the student eventually proposes to become a specialist. I say not only that there is no reason why this should not be done; but, on the ground of practical experience, I venture to add there is no difficulty in doing it." * * * He then refers to the success of the Royal School of Mines. * * "Nothing would help the man of science of the future to rise to

the level of his great enterprise more effectually than certain modifications, on the one hand, of primary and secondary school education, and on the other, of the conditions which are attached by the Universities to the attainment of their degrees and their rewards.

"We have a right to claim that science shall be put upon the same footing as any other great subject of instruction, that it shall have an equal share in the schools, an equal share in the recognized qualification for degrees, and in the University honors and rewards.

"It must be recognized that science, as intellectual discipline, is at least as valuable, and, as knowledge, is at least as important as literature, and that the scientific student must no longer be handicapped by a linguistic (I will not call it literary) burden, the equivalent of which is not imposed upon his classical compeer.

"Let me repeat that I say this, not as a depreciator of literature, but in the interests of literature. The reason why our young people are often so scandalously and lamentably deficient in literary knowledge, and still more in the feeling and desire for literary excellence, lies in the fact that they have been withheld from a true literary training by the pretence of it, which too often passes under the name of classical instruction. * * *

"Nothing is of more importance to the man of science than that he should appreciate the value of style, and the literary work of the school would be of infinite value to him if it taught him this one thing. But I do not believe that this is to be done by what is called forming one's self on classical models, or that the advice to give one's days and nights to the study of any great writer is of much value.

"*Le style est l'homme même*" as a man of science who was a master of style has profoundly said; and aping somebody else does not help one to express oneself. * * * * * *

"A good style is the vivid expression of clear thinking, and it can be attained only by those who will take infinite pains, in the

first place, to purge their minds of ignorance and half knowledge, and in the second, to clothe their thoughts in the words which will most fitly convey them to the minds of others.

"I can conceive no greater help to our scientific students than that they should bring to their work the habit of mind which is implied in the power to write their own language in a good style.

"But this is exactly what our present so-called literary education so often fails to confer, even on those who have enjoyed its fullest advantages; while the ordinary schoolboy has rarely been even made aware that its attainment is a thing to be desired."

Lord Rayleigh, in his Presidential Address to the British Association, at Montreal, says:—"It can hardly be denied that their supremacy (*i.e.* of the dead languages in school education) is the result of routine rather than of argument * * * * I do not myself take up the extreme position. I doubt whether an exclusively scientific training would be satisfactory; and where there is plenty of time and a literary aptitude I can believe that the Latin and Greek may make a good foundation. But it is useless to discuss the question upon the supposition that the majority of boys attain either to a knowledge of the languages or to an appreciation of the writings of the ancient authors. The contrary is notoriously the truth; and the defenders of the existing system usually take their stand upon the excellence of the discipline. From this point of view there is something to be said. The laziest boy must exert himself a little in puzzling out a sentence with grammar and dictionary, while instruction and supervision are easy to organise and not too costly. But when the case is stated plainly, few will agree that we can afford so entirely to disregard results.

"In after life the intellectual energies are usually engrossed with business, and no further opportunity is found for attacking the difficulties which block the gateways of knowledge. Mathematics especially, if not learned young, are likely to remain unlearned. I will not further insist upon the educational importance of mathematics and science, because with respect to them I shall probably be supposed to be prejudiced.

"I believe that French and German, if properly taught, which I admit they rarely are at present, would go far to replace Latin and Greek from a disciplinary point of view, while the actual value of the acquisition would in the majority of cases be incomparably greater. In half the time usually devoted without success to the classical languages, most boys would acquire a really serviceable knowledge of French and German. History and the serious study of English literature, now shamefully neglected, would also find a place in such a scheme."

Herbert Spencer, in his essay upon Education which appeared in the *Westminster Review* for July, 1859, since reprinted with his other works on Education, makes the following remarks :—

"Among mental as among bodily acquisitions, the ornamental comes before the useful. Not only in times past, but almost as much in our own era, that knowledge which conduces to personal well-being has been postponed to that which brings applause.

"In the Greek schools, music, poetry, rhetoric and philosophy, which, until Socrates taught, had but little bearing upon action, were the dominant subjects ; while knowledge aiding the arts of life had a very subordinate place. And in our own Universities and schools at the present moment, the like antithesis holds. We are guilty of something like a platitude when we say that throughout his after-career, a boy, in nine cases out of ten, applies his Latin and Greek to no practical purposes. The remark is trite that in his shop or his office, in managing his estate or his family, in playing his part as director of a bank or a railway, he is very little aided by his knowledge he took so many years to acquire—so little that generally the greater part of it drops out of his memory ; and, if he occasionally vents a Latin quotation or alludes to some Greek myth, it is less to throw light on the topic in hand than for the sake of effect. If we inquire what is the real motive for giving boys a classical education, we find it to be simply conformity to public opinion. Men dress their children's minds, as they do their bodies, in the prevailing fashion. As the Orinoco Indian puts on paint before leaving his hut, not with a view to

any direct benefit, but because he would be ashamed to be seen without it; so, a boy's drilling in Latin and Greek is insisted on, not because of their intrinsic value, but that he may not be disgraced by being found ignorant of them—that he may have 'the education of a gentleman'—the badge marking a certain social position, and bringing a consequent respect.

* * * * *

"Men who would blush if caught saying Iphigénia instead of Iphigenía, or would resent as an insult any imputation of ignorance respecting the fabled labours of a fabled demi-god, show not the slightest shame in confessing that they do not know where the Eustachian tubes are, what are the actions of the spinal cord, what is the normal pulsation, or how the lungs are inflated. While anxious that their sons should be well up in the superstitions of two thousand years ago, they care not that they should be taught anything about the structure and functions of their own bodies—nay even wish them not to be so taught. So overwhelming is the influence of established routine—so terribly in our education does the ornamental over-ride the useful?"

The opinions of many others might be also cited, but the above are perhaps sufficient.

Although written nearly thirty years ago, Mr. Spencer's remarks are nearly as applicable to-day as when they were penned, and should be read by every one. I have quoted these opinions, and referred to the matter more particularly in reference to school education in the Colonies, since at the University the science and professional student is now, after many a hard struggle, emancipated from most of the old classical fetters in cases where he has not the time or inclination to proceed with such studies.

Mr. Spencer evidently regards the compulsory and often unreasoning drilling in the classical languages as a fashion which came in a few centuries ago, and which will also work itself out in time.

I believe that amongst a few there still lingers an antiquated notion that the study of science is not so respectable as that of the classics; and scholars on what is termed the modern side

of a school are somewhat looked down upon, and regarded as inferior to those on the so-called classical side—thus bearing out the notion which, if my memory serves me aright, Lord Chesterfield impressed upon his son, viz., that it was the distinguishing mark of a gentleman to know Greek.

Most of the older writers who have laid so much stress on the advantages of a merely classical education over a mixed literary and scientific education, and therefore a really liberal one, were not properly qualified to judge or give an opinion, for they only knew one side of the question, and were necessarily, although perhaps unconsciously, more or less prejudiced; whereas all or nearly all of those who have upheld the claims of science to have a part in a general and really liberal system of education have been through the classical mill as well as the scientific, so that they have the advantage of experience of both systems.

The ordinary classical and mathematical education cannot properly be regarded as a liberal one, since it only attempts to educate one portion of the student's faculties; his powers of observation, and of reasoning from such observations, are entirely neglected and undeveloped.

It must not be thought that I wish to disparage the study of the classics—such is far from my thoughts—it is quite fitting and necessary that some should devote their lives to such subjects; but boys should be relieved from the useless drudgery of subjects in which they are not likely to distinguish themselves nor obtain much profit from the alleged beneficial discipline which these subjects are said to impose.

As far as I can learn, there is almost an entire absence of real instruction in even the most elementary science in the schools of this Colony. In some few schools I understand that a little instruction is given in the form of lectures practically illustrated by experiments, but I do not know of any case where the boys themselves perform experiments with their own hands, although of course there may be such. If I am wrong, I shall be only too glad to be corrected upon this point.

Judging from my experience as an examiner, I should say that by far the largest majority of the candidates who present themselves for the Matriculation, Public, and similar Examinations, in science, have not only never performed any of the most elementary experiments for themselves, but have not even seen them performed nor the instruments which they often glibly enough describe from books; and they would probably be dumbfounded if the simplest piece of apparatus itself were placed before them, and they were asked to perform an experiment with it.

In my experience it is no uncommon thing for a candidate to reproduce the book description of a common rock, mineral or fossil, but fail to recognise the same when the actual thing itself is placed before him for description. He has perhaps described a piece of granite correctly, according to the book or his teacher, but has failed to recognize a common and characteristic specimen of it when placed before him at the same time for recognition, although allowed ample time to examine it minutely.

It is not instruction of that kind which is required—that is merely cram, and of a bad kind; it is the teaching which is at fault, not the scholar's want of capacity; he has probably done his best, and if he had received real instruction, would have gained real knowledge, and not the false half-knowledge referred to.

Until this is remedied, we cannot hope for very much progress in primary scientific education.

As at home, a certain minimum compulsory number of experimental illustrations should be given by the teacher, when the knowledge imparted, although smaller in amount, *i.e.* covering less ground, would be of real value as far as it goes.

There are several drawbacks to the pursuit of science, especially in the Colonies, which deter many from taking a degree in science instead of in arts. One is the fact that it is easier for a lad who has had the ordinary school education to take a degree in arts, for which he has already done much of the work, than in natural science subjects, which are probably quite new to him, and another

is that the student in the natural sciences has at present usually but very little prospect of any great pecuniary success in life, in spite of their having been termed the "bread and butter" sciences.

The openings are but few, and usually not well paid. The necessity of having well-trained scientific managers to mines, metallurgical works, and manufactories, is hardly yet recognized —and certainly this is the case in the Colonies.

In many cases it would pay companies to have a Manager well trained in scientific principles, at the rate of even £3,000 or £4,000 a year, instead of a more or less incompetent one at a small salary, as is too often the case; the thoroughly trained man would often make the difference between failure and success.

The Board of Technical Education is now doing good work in spreading elementary, scientific, and technical education over the Colony, by means of science classes in Sydney and at various centres outside of Sydney, and in a less systematic manner by the aid of itinerant lectures. The latter are sent out mainly to draw attention to the fact that there are educational subjects other than the ordinary school courses, and to help to create a taste for such. Many people who are considered fairly well educated are quite ignorant of such matters, and lie under the impression that the subject of physics deals with drugs, and the subject of chemistry with the art of compounding and dispensing the same, so that if they are only taught that physics deals with the forces of nature some good has been done; for of course we cannot expect much to be learnt from an attendance upon one or two more or less popular lectures; it is more or less true, as has been said by Faraday, "popular lectures do not really teach, and lectures which really teach are not popular."

It is gratifying to find that the necessity of scientific education is gradually being realized in other quarters; and it is satisfactory to notice that at the present time there is a motion before the Legislative Assembly to place the sum of £10,000 upon the Estimates for the establishment of Schools of Mines in the various

mining centres, although the amount is quite insufficient for the purpose. It is highly probable that one really good central School would be in every way preferable and much more efficient.

A School of Mines pure and simple could not possibly have a large number of students, while it is a most expensive institution to maintain. The best plan is to attach a mining department to some existing scientific institution, or to found such with provision for instruction in mining. Even at home—with its population of 35,000,000 to draw from, the Royal School of Mines never had a large number of students, and in order to lessen the expense by more fully utilizing the staff and appliances it has been recently amalgamated with the Normal School of Science.

Apparently but few, however, are aware that at the present moment there are practically two Schools of Mines in Sydney already.

At the University we have provided for a Mining Department or School, and instruction is afforded at the present time in all the subjects but two, and lecturers would doubtless be at once appointed in those subjects if any students presented themselves, but up to now none have come forward, although the existence of the department has been made public.

Then at the Technical College, Sydney, under the Technical Board, a fairly complete course of instruction in all branches suitable for the miner are given, including mining itself, which is not taught at the University, for the reason given; but the number of students is so small that it is almost a question whether the Board is justified in continuing the outlay for this department.

The Board also is giving instruction in mineralogy, geology, and other allied subjects needed by the miner in certain of the country mining districts, but the attendance of students leaves much to be desired.

Although the number of persons presenting themselves for instruction in mining is not so great as we might expect from the appeals which are made from time to time, I do not think that is a very strong reason against trying to meet the actual want;

but there is no doubt that many who are crying out for technical education do not seem to be aware how far their wants have been supplied, and that the technical education which they are asking for is in some instances being given and the classes are languishing for want of students. There appears to be a difficulty in some cases in bringing the student and the instructor together. There is no doubt whatever as to the dearth of educated men capable of taking the management of mines.

There is another motion to be brought before the Legislative Assembly, to make provision for the creation and endowment of twenty scholarships, of the value of £200 per annum, each tenable for three years, at the Sydney University. This proposition if carried will I am sure be followed by satisfactory results to the holders; it will still further utilize existing teaching powers at the University, and I trust it will be put into execution.

As another instance of the way in which the existing agencies for technical education are not fully recognized, I may mention that very few appear to be aware that we have in our midst the nucleus of a very good Technological Museum, at present obscurely and indifferently sheltered in the old Agricultural Hall in the Domain. The collections would have been much more complete had it not been for the loss of all the first collections in the Garden Palace fire; but in spite of that, the managing Committee have already quite sufficient material to fill a much larger building than the present temporary and unsuitable one. Many things cannot be shown at all, and the others are so overcrowded it is difficult for visitors to examine them properly, and moreover they suffer from the combined attacks of the sun, wind, and rain, for the iron shed in which they are housed is by no means weather-proof.

A special feature in the Museum is the series of educational appliances, and especially of cheap and simple sets of physical, chemical, and other apparatus, geological and other collections, for the use of schools and teachers, so arranged that they can see the kind of apparatus to be employed and its cost.

I do not refer to what has already been done for technical education to stay the hands of any one, because a vast amount more requires to be done, but merely to draw attention to the presence of existing educational agencies in this direction.

Professor Huxley, in his Anniversary Address to the Royal Society, in November last, speaking of the Fellowship, says:—"Since this Society was founded, English-speaking communities have been planted, and are increasing and multiplying in all quarters of the globe; to use a naturalist's phrase, their geographical distribution is 'world-wide.' Wherever these communities have had time to develop, the instinct which led our forefathers to come together for the promotion of natural knowledge has worked in them and produced most notable results. The quantity and quality of the scientific work now being done in the United States moves us all to hearty admiration; the Dominion of Canada, and our Colonies in South Africa, New Zealand, and Australia, show that they do not mean to be left behind in the race; and the scientific activity of our countrymen in India needs no comment.

"Whatever may be the practicability of political federation for more or fewer of the rapidly growing English-speaking peoples of the globe, some sort of scientific federation should surely be possible.

"Nothing is baser than scientific Chauvinism, but still, blood is thicker than water." And he further says—"I have often ventured to dream that the Royal Society might associate itself in some special way with all English-speaking men of science; that it might recognize their work in other ways than by the rare opportunities at present offered by election to our Foreign Fellowship, while they must needs be deprived of a large part of its privileges.

"How far this aspiration of mine may be reciprocated by our scientific brethren in the United States and in our Colonies I do not know; I make it public on my own responsibility, for your and their consideration."

Doubtless all agree with Prof. Huxley that it is desirable to have closer bonds of union between the Royal Society and the

men of science who are scattered over the wide areas of English-speaking countries, but it does not appear to be very easy to suggest a method for bringing this about.

It is really very difficult to suggest any improvement upon the present relationship between the parent Society and non-resident English-speaking men of science certainly as far as the Colonies are concerned, for any one who really does good work in the Colonies is seldom overlooked, but his merits are usually duly acknowledged by election to the Fellowship of the Royal Society.

There are probably many earnest workers in science in English-speaking countries who would like to be connected with the Royal Society, and who are well fitted, as far as attainments go, to be elected to its Fellowship; but I fear that many difficulties will be met with in trying to bring about any change in the present system.

One amongst others is, that the number of Fellows, at present limited to 500, would have to be very largely increased; for if we assume that there are sixty to seventy millions of the English-speaking race resident elsewhere than in the United Kingdom, and the proportion of men worthy and desirous of the undoubtedly great honor of its Fellowship be anything like that amongst those resident in the United Kingdom, then the 500 would have to be made at least 1,000, and probably much more, a number which would swamp the old Royal Society.

Personally I am inclined to think, as a beginning (I, however, make the suggestion with considerable diffidence and with all respect), until some workable scheme has been evolved, that perhaps the Royal Society might be able to grant certain privileges to the members of the older and recognized Colonial and American Societies. The members of the branch Societies—for the Colonial and American Societies are really offshoots of the original Royal Society—when visiting the old country might be given increased privileges for attending its meetings, be allowed access to its valuable library, &c., and they might perhaps be granted copies of its publications at reduced prices.

It is true that at present the Royal Society's rules are so liberal that a visitor need seldom be debarred from attending its meetings, yet increased facilities might be granted to a certain number of properly accredited members of external Societies.

Another way in which the Royal Society and other scientific Societies at home could render us material help is by giving us assistance in the publication of our papers. Too often a paper read before a colonial Society is practically not published at all outside of the particular Colony in which it is read and printed.

Although the publications of the colonial Societies are usually distributed to the principal Societies and Journals outside of the Colonies, yet but few people see them. The book is placed on the library table or shelves, and is perhaps just glanced at by one or two; whereas if abstracts of the papers which it contains, or even their titles, were to be more regularly inserted in the publications of the home Societies, more use would be made of the work done in the Colonies and America. In the case of the more valuable papers, it might be desirable to have the whole of the contributions published in the Journal of some home Society; arrangements could readily be made so that the paper should appear simultaneously at home and in the Colony. Any such recognition would, I am sure, do a great deal to further the advancement of science in the Colonies.

Now-a-days few have the time to unearth books in a large library; to reach the person for whom it is intended, the paper must be placed in his hands, or otherwise closely brought under his notice.

In the same way it might be arranged that papers written in England, America, and elsewhere, upon matters interesting in the Colonies, might be simultaneously read and published by the Colonial Societies.

After a paper has been published (*i.e.*, technically) in the Colonies, although very few have seen or heard it, no other scientific Society according to the present custom can pay any attention

to it, so that to all intents and purposes the matter remains unpublished. Hence, as I have already said, publication in the Colonies is too often practically no publication.

The effect of this is often seen in popular books upon the Colonies, and in some too which are not intended to be popular, where the same long exploded errors are carefully reproduced by generation after generation of writers.

Whether the late distinguished President of the Royal Society is able or not to carry out his wishes, we cannot but be grateful to him for the full recognition he makes of our efforts to follow in the footsteps, although in but a feeble way, of the grand old parent Society.

On September 16, 1884, the following letter appeared in the Sydney papers, and was afterwards reproduced by most of the other Colonial and some of the Home papers :—

"THE BRITISH ASSOCIATION.

"To the Editor.

"Sir,—During the past fortnight we have received several telegrams from London respecting the late meeting of the British Association at Montreal, and in some of them references are made to suggestions that a future meeting should be held in Australia.

"As far as one can judge, the idea seems to have been thrown out when Professor Moseley, F.R.S., announced Mr. Caldwell's discovery of the oviparous nature of the platypus and Australian porcupine.* The news seems to have created or rather re-awakened interest in the peculiarities of Australian Natural History, and on the spur of the moment some of the more enthusiastic members appear to have proposed that a subsequent meeting of the British Association should be held in Australia.

"The Victorian Premier, with commendable promptitude, at once telegraphed the necessary invitation for the Association to visit Melbourne next year; an invitation might also have gone from Sydney, and especially under the circumstances. Without such invitation the meeting is not likely to take place here, for the

* Sent from Sydney by cable.

Association only visits towns to which it is invited, and generally there is more or less competition amongst the principal towns to secure the acceptance of their invitations, and to bring this about the competing towns offer as many attractions as possible.

"For the Montreal Session all the great English Steamship Companies between England and America, and the Canadian and United States Railway Companies reduced their fares to members and their families; the Government Railways were, of course, made free to them, and the Telegraph Companies also granted free use of their lines all over Canada and the United States. Numerous free excursions were arranged to places of interest, some extending over a period of twelve or fourteen days, the members and their families merely paying for their meals and sleeping-berths at quite nominal rates.

"In addition to the reductions made by the Steamship Companies, the Canadian Committee voted $14,000 for the purpose of still further reducing the cost of members' (and of their relatives') passages to Canada. The Australian Colonies would of course gladly help in the same way; but, taking the much greater expense and time of voyage into account, the amount to be raised here would have to be many times as much.

"I am however very much afraid that, although Australia, New Zealand, and the Islands offer great attractions to many of the members (I know of one eminent scientific man who is returning to England *via* Australia from the Montreal meeting), yet but comparatively few could afford the time and money to come out here. The visit to Montreal and the excursions through Canada and the United States could all be managed in a month or six weeks, and at a comparatively small expense—in fact, most of those who went to Canada made the trip do duty for the annual autumn holiday or visit to the seaside; but out of the 2,000 to 3,000 members and associates (2,714 attended the Southport meeting in 1883) only a comparatively small number could arrange to visit Australia; the round voyage could scarcely be squeezed into the long vocation of those fortunate enough to have one, and the

necessary travelling expenses would considerably exceed the whole year's income of many—for the pursuit of science is not a lucrative one, and as a rule its followers are poor. Hence, taking all things into account, I do not think we could expect more than fifty members, if so many. And unless some 400 to 500 attended (between 800 and 900 entered their names for the Montreal session) the gathering could scarcely be considered as a meeting of the British Association. Therefore, instead of looking for a near visit from the Association, I would suggest that we should rather be preparing the way for issuing an invitation later on, when we have made suitable provision to entertain our intended Scientific guests; and as a preliminary step I would venture to suggest, as a life member of the parent Association, that we might try to bring about a federation or union of the members of the various Scientific Societies in Australia, Tasmania, and New Zealand into an Australasian Association for the advancement of Science on the lines of the British Association, with a view to hold the first general meeting in Sydney on the hundredth anniversary of the Colony, when there will probably be an International Exhibition to celebrate that event. With the combined attractions we might hope to gather together a very fair number of scientific visitors to take part in the proceedings.

"I mooted this question during the last Exhibition in Sydney in 1879, but matters seemed hardly ripe for it; but now, perhaps, with the greater advancement in numbers and in wealth something might come of it in 1888.

"The details for an Association suited to the scattered Australasian Colonies necessarily offer some difficulties, but they can all be more or less readily overcome, and I hope to be able shortly to communicate with the different Societies to discuss the necessary arrangements.

"After the first meeting the gatherings could take place annually, or every two or three years, in one of the principal towns in Australasia, as agreed upon by the members.

"I am sure that such an Association—which must come sooner or later, if we are to hold our own—would not only do a great deal for the advancement of science in the Colonies, but would also materially favour their progress in many other ways.

"Trusting that this letter may bring about an expression of opinion upon the matter,—

"I am, &c.,

"A. LIVERSIDGE.

"The University, September 16, 1884."

I am still of opinion that arrangements should be made for holding such a meeting in 1888, and for founding the proposed Australasian Association for the Advancement of Science, and I shall be glad if those who are in favour of it will kindly send me their names as intending members, so that the necessary preliminary steps can be taken.

The regulations for the Australasian Association might be drawn up on the same general lines as are followed by the parent Association, but with certain modifications to suit our local circumstances; they might be somewhat as follows:—

There should be a General Committee or Council, having the supreme control, to be composed of delegates from the different Colonies or Colonial Scientific Societies, who could be elected or appointed according to some scheme to be decided upon. The number of delegates from each Society or Colony should be proportionate to the number of members subscribing or otherwise taking part in the proceedings; each Society might be allowed to nominate a delegate for each one hundred members.

A local Committee would be required in the place of meeting, to make arrangements for the reception and entertainment of the visitors, and to make preparations for the business of the General Meetings.

Sectional Committees would also require to be appointed for the following subjects:—

Section A.—Astronomy, Mathematics, Physics and Mechanics.

Section B.—Chemistry and Mineralogy.
Section C.—Geology and Palæontology.
Section D.—Biology.
Section E.—Geography.
Section F.—Economic Science and Statistics.
Section G.—Anthropology.
Section H.—Medical and Sanitary Science.
Section I.—Literature and the Fine Arts.
Section J.—Social Science.

The rights and privileges of membership should be in the main similar to those afforded by the British Association, subject to revision and alteration after the first meeting of the proposed Australasian Association for the Advancement of Science.

Should the proposal meet with approval, it will be necessary to take immediate steps in order that all arrangements may be ready for 1888.

If the General Committee were appointed on the basis suggested, viz., one delegate to each 100 members or less, the total number of such representatives would be about twenty-five to thirty, since there are some twenty recognized Scientific Societies in the Australasian Colonies, and the number of members between 2,500 and 3,000.

From the above numbers it does not appear unreasonable to expect a sufficient number of papers to make the meeting a success.

In addition to the papers, excursions would of course be organized to various places of interest, such as the Jenolan, Wambeyan, and other Caves, the Blue Mountains, and similar places of interest to geologists.

Probably the best and most suitable place for the general and other meetings would be the University, as it is the only building in Sydney which possesses a sufficiently large hall and the requisite rooms for the sectional meetings.

The objects of the British Association are as set forth as follows, and the proposed Australasian Association would probably do well to try and follow the same lines:—"The Association contemplates no interference with the ground occupied by other institutions. Its objects are—to give a stronger impulse and a more systematic direction to scientific inquiry—to promote the intercourse of those who cultivate science in different parts of the British Empire, with one another and with foreign philosophers—to obtain a more general attention to the objects of science, and a removal of any disadvantages of a public kind which impedes its progress."

Amongst its rules which might also be adopted are these—I have modified them to suit our circumstances :—

All persons who have attended the first meeting shall be entitled to become members of the Association upon agreeing to conform to its rules.

The Officers, Members of Council, Fellows, and Members of Literary and Philosophical Societies, publishing Transactions or Journals in the British Empire, shall be entitled in like manner to become members of the Association. Persons not belonging to such Institutions shall be elected by the General Committee or Council to become life members of the Association, annual subscribers, or associates for the year, subject to the approval of a general meeting.

All members who have paid their subscriptions shall be entitled to receive the publication of the Association *gratis*.

The Association shall meet for one week or longer. The place of meeting shall be appointed by the General Committee two years in advance.

The first meeting of the British Association was held in 1831, and it was attended by 353 members, since that date the numbers have increased very largely, and close upon 3,000 members and associates have been present at the later meetings, and even at the Montreal meeting the number was 1,777 ; of which 235 were old life members, 20 new life members, 317 old annual members, 219 new annual members, 826 associates (*i. e.* members for the

particular meeting only), 74 ladies, and 26 foreign members ; and 60 members of the American Association who were admitted as honorary members for the meeting. The returns for the Steamship Companies show, as far as they go, that they carried across some 747 members. The Montreal meeting under the presidency of Right Hon. Lord Rayleigh, was a great success, in spite of the distance from its head-quarters at which it was held.

The Montreal meeting is of rather more interest to residents in Australia than usual, since at it was made the announcement by cable of the successful results of Mr. Caldwell's investigation into the oviparous nature of the echidna and platypus.

The Parliament of the Dominion of Canada voted $25,000 towards the expenses of the meeting. Fifty officers of the Association had the cost of their return passages defrayed out of this sum ; old members received vouchers defraying about one-third the cost of return ticket, and in addition, certain of the Steam Companies reduced their fares to members of the Association, and to three of their near relations who accompanied them. The City Council of Montreal supplemented the Government grants by $5,000, and the citizens subscribed another $10,000.

Local Committees, and an influential Citizens' Committee, under the Presidency of the Mayor of Montreal, were appointed to make general arrangements for the meeting, and for the reception, lodging, and entertainment of the members. The head quarters of the Association were at the beautifully situated M'Gill College. The Presbyterian, Wesleyan, and Congregation Colleges were also placed at the disposal of the Association for meetings of the Sections, &c.

All the most prominent and distinguished residents, not only in Montreal, but in Canada generally, seemed to have vied with one another in extending their hospitality to their visitors, and in endeavours to make their stay a pleasant one ; visits and excursions were planned for all, some of great length, and welcomes were extended from every quarter, extending from the Governor-General downwards. About 140 residents in Montreal alone each received

from two to six guests in their houses, and, from the account of the Montreal meeting given by General Sir J. Henry Lefroy, K.C.M.G., C.B., F.R.S. to the Colonial Institute, the gathering must have been very interesting and most enjoyable. Any one wishing for further particulars should consult his paper, to which I am indebted for some of the above references to the Montreal meeting.

Although so many old members of the British Association visited Canada, including nearly all its most distinguished members, we cannot, I think, as I said in my letter, reasonably expect the British Association to visit Australia for some years to come, but I think that if we arrange for a gathering of all the most prominent scientific men and well-wishers of science in Australia, and invite the members of the British and American Associations to visit us, we may probably have a fair number of visitors.

There is no doubt that a meeting of the kind held during the centennial year would confer great benefit upon the Colonies and convey much instruction to our visitors. It would afford a unique opportunity for the exchange of ideas and information; and it would not only have an immediate beneficial effect, but would permanently raise the high-water-mark of thought in all the Colonies, and especially in connection with scientific matters. It would tend to stimulate all classes, and disseminate a taste for most branches of knowledge.

The British Association meeting at Montreal seems to be regarded on all hands as having been a success from every point of view—from the special scientific one of the Association itself, and from the picnic point of view of those who merely went for pleasure.

At the Sydney meeting in 1888 the opportunity should be taken to take stock, as it might be termed, of all scientific matters more particularly connected with Australasia.

It would be a splendid opportunity to correlate and correct all the scattered and fragmentary geological maps and memoirs relating to the various Colonies, and to adopt a uniform system of nomenclature, colouring, &c., for all Australasian geological maps.

It would be beneficial if botanists were to prepare and revise the census of plants for each Colony, especially to show their distribution; and similar questions could be discussed by the zoologists for land and marine organisms.

If the proposed Australian Association for the Advancement of Science should really become an accomplished fact, as I hope it will—for progress in material affairs cannot well be expected, and certainly will not be made unless a corresponding advancement be first made in science—we should not necessarily be compelled to hold yearly meetings at first. The head-quarters, however, of the Association could not conveniently be shifted every year; but, so that each Colony should have an equal share in its affairs, the offices might be moved at stated intervals from capital to capital.

I must crave your indulgence for the length of my remarks. The matter has grown under my hands, and I find myself, unfortunately, without the time to give it that somewhat ruthless pruning which I feel it needs.

With this my duties as President cease; and it now only remains for me to express the pleasure I have had in endeavouring to fill the office to the best of my ability, and to hope that the Society may have a long and flourishing career. It has, I think, safely got over most of the troubles incidental to such Societies in new countries. We now have a large roll of members, the largest of any single Society in any of the Colonies; we have the nucleus of a good special library, and a fairly comfortable and commodious house and hall for our meetings; whereas a few years back the whole of our chattels and effects were carried backwards and forwards by the Assistant Secretary in a carpet-bag; so that it now only remains for us to make a reputation for the Society by the character and amount of the work which is done under its auspices.

Description of an unrecorded Ardisia of New Guinea.

By Baron Ferd. Von Mueller, K.C.M.G., M.D., Ph.D., F.R.S., F.L.S., &c.

[*Read before the Royal Society of N.S.W., 2 June, 1886.*]

Ardisia porantherea, F. v. M. & C. Moore.

Glabrous; leaves large, chartaceous, lanceolar, somewhat acuminated, narrowed into a short petiole, shining on both sides, hardly paler beneath, entire at the margin, copiously pervaded by transparent short lineoles and dots; umbels crowded into short terminal panicles; pedicels about as long as the umbel stalks or longer; flowers pentamerous; segments of the calyx elliptical, membranous at the margin; corolla pale-bluish or almost lilac-coloured, nearly twice as long as the calyx, its lobes about three times longer than the pale tube, broad-oval; filaments hardly half as long as the anthers; the latter yellow, from a somewhat bilobed base broad-linear, gradually attenuated upwards, opening introsely by two terminal confluent pores, considerably shorter than the corolla; style hardly surpassing the stamens, setaceous, as well as the ovary glabrous.

New Guinea.—Cultivated in the Botanic Gardens of Sydney by Chas. Moore, Esq., F.L.S. A large elegant plant, of seemingly climbing habit; leaves dark green, to 7 inches long and to $2\frac{1}{2}$ inches broad, thinly penninerved, finely net-veined. Panicles much shorter than the leaves, the general peduncles bearing umbel-stalks already from near the base. Pedicels mostly twice as long as the flowers. Bracts conspicuous, cymbous-lanceolar, at first outside soft-hairy, soon deciduous. Segments of the calyx about $\frac{1}{6}$ inch long, densely lineolar and punctular-spotted except towards the hyaline margin. Corolla tender-membranous, its resinous lineoles and dots dark-brownish, its lobes quite blunt. Anthers about $\frac{1}{8}$ inch long. Stigma not broader than the summit of the style; fruit as yet not obtained. In its affinity this new species approaches to A. porosa from Malacca and the Sunda-Islands, forming with that plant and with A. paludosa from Madagascar the section Monoporus, which might perhaps be restored to generic right, unless carpologic characteristics, against expectation, should be found to interfere with this segregation. A porosa differs already in less resinous-glandular leaves and in racemously arranged flowers of smaller size from the new Papuan congener.

A Comparison of the Dialects of East and West Polynesian, Malay, Malagasy, and Australian.

By the Rev. George Pratt.

[*Read before the Royal Society of N. S. W., 2 June, 1886.*]

Some of these dialects were collected from missionaries and some from books. The orthography is sometimes peculiar and arbitrary, *i.e.*:—

In Lifu j stands for th,
c for ch, as in *church*,
q for wh,
x for ch, as in *loch*,
ë is much like i in *vin* (French),
ö as eu in *monsieur*,
k is hard g.

The natives call a fowl either kutu or gutu.

Malagasy sounds o as u. There are thirty-four Eastern Polynesian roots among this list of Malagasy words; and there are sixty-six East Polynesian roots among the Malay words. These words were selected from the various dialects of Malay given by Wallace, and from the Malay dictionary. Kanala (New Caledonia) abounds in double consonants—ng, mb, kh, kw. It has three consonants coming together—ndra, but the nd is rather a nasal d than two letters.

The Australian dialects (except Kamilaroi) are written after Captain Cook's plan, namely, giving the sounds in English letters, as beerai for birai.

It will be observed that the East Polynesian dialects are substantially branches of one language; whereas the Western Polynesian dialects entirely differ, and have very little in common even among themselves. I found over 100 Eastern Polynesian words in the Duke of York Dictionary; I account for the presence of these words to be owing to driftaways effecting a settlement among these people. Such, we know, happened in two instances. A large party of Tongans and Samoans reached Efate (New Hebrides) and

settled there by force ; and a party of Wallace Islanders took possession of one end of the island of Iai, in the Loyalty Group, and these have preserved their language almost pure. Australian words differ entirely from both East and West Polynesian.

English	Ashes	Back	Bad	Belly
Malay	lavu	balākang	leak	prut
Samoan	lefulefu	tua	leanga	manava
Rarotongan	reu ai	tua	kino	kopu
Maori	pungarehu	tuara	kino	kopu
Tongan	efu	tua	kovi	ngete
Tahitian	rehu	tua	ino	opu
Hawaii	lehu	kua	ino	ka opu
Marquesas		tua	pe	opu
Fijian	dravu	daku	tha	kete
Malagasy	lavenona	lamosina	ratsy	kibo
Nikunau	bareka	akuna	buakaka	birotona
Motu	rahurahu	dolu	dika	boga
Duke York	kabū	maru	aka	balā
Lifu	*hnatisije	hutrö	ngazo	hni
Iai	dru	joan	kong	neakon
Kanala		dūri	sa	
Aneityum	nohpa	incehin	has	netgan
Tasmania	tontaiyenu	me inghana	noweiack	
S. Australia	dalba	dardage	warra	
Kamilaroi	kerran	gūria	kagil	mūbal
Dippil				
Victoria			nūlam	

*hn is a nasal sniff ; j is dh.

English	Black	Bird	Blind	Body	Blood
Malay	mete	manu	būta	badan	dara
Samoan	uliuli	manu	tauaso	tino	toto
Rarotonga	uriuri	manu	matapo	kopapa	toto
Maori	mangu	manu	matapo	tinana	toto
Tonga	uliuli	manu	ngui	tino	toto
Tahiti	ereere	manu	matapo	tino	toto
Hawaii	eelee	manu	makapo	kino	koko
Marquesan	keekee	manu	matapo	tino	toto
Fiji	loaloa	manumanu	matapoko	yango	dra
Malagasy	mainty	voroma	jamba	tena	ra
Nikunau	rarō	mani	matana	rabatana	rarā
Motu	korema-k	māmu	matakepulu	tau	rara
D. York	marut	pika	pula	kamanom	lap
Lifu	wetewet	waco	timek	ngoneteï	madra
Iai	lit	meno	wadru	unyin	dra
Kanala	nguru	nenu			
Aneityum	apig	iuman	apat nesganimt	nohun	inja iran
Tasmania	mabama	pugunyena			wargata mina
S. Australia	moan		muga		baru
Kamilaroi	bului	tigdara			guë
Dippil					
Victoria					

English	Bone	Born	Breast (f.)	Butterfly	Chief
Malay	ruri	per-anak	sūsū	pepeül	pangulu
Samoa	ivi	fanau	susu	pepe	alii
Rarotonga	ivi	anau	ū	pepe	rangatira
Maori	iwi	whanau	u	pepepe	ariki
Tonga	hui	fanau	huhu	pepe	eiki
Tahiti	ivi	fanau	u	pepe	arii
Hawaii	iwi	hanau		pulelehua	alii
Marquesan	ivi		u		kakaiki
Fiji	sui	sa suthu	sere	bebe	turanga
Malagasy	taolana	teraka	tratra	lolo	andriana
Nikunau	ri	buñi		bobe	uea
Motu	turia			kaubebe	lohiabada
D. York	uri	bubuta	tu	toto	tadaru
Lifu	june	hnahon	imano	fenefen	jochu
Iai	jeien	nokon	basin	walelaba	than
Kanala	nīre				aukha
Aneityum	neduon	apos		mokemoke	natimarid
Tasmania			parugana		
S. Australia			beep		
Kamilaroi	būra	tangine	ngummu		durunmi

Fiji—c is th. The double consonants are no infringement of the rule against two consonants coming together; d is always dr; ng is always nasal, &c.

Nikunau is one of the Gilbert group.

English	Child	Cloud	Come	Dark	Day
Malay	anak	awan	o mai	klam	aoaaoa
Samoa	tama	ao	o mai (pl.)	pouliuli	ao
Rarotonga	tamaiti	tumurangi	aere mai	poiri	ao
Maori	tamaiti	ao	haere mai	pouri	ao
Tonga	tama	ao	hau	pouli	aho
Tahiti	tama	ao	haere	pouri	ao
Hawaii	kama	ao	hele mai	poeleele	ao
Marquesan	tama	ao	hee mai	potano	a
Fiji	ngone	loaloa	lako mai	butoputo	siga
Malagasy	zanaka	rahona	avia	maizina	andro
Nikunau	tei	nañi	nakomai	karoro	boñ
Motu	natuna	dagadaga	mai	dibura	dina
D. York	nat	bakut	wan	boboto	bung
Lifu	nekönat	iawe	ɔrohimi	melohlem	drai
Iai	wanakat	ulah	o	lit	bong
Kanala	khüse	kwo	menge	nguru	
Aneityum	inhalav	napat	ham	poig	nadiat
Tasmania				tagremapac	
S. Australia					gedala
Kamilaroi	kai	gundar	taiyanani		yeradha
Dippil		mirrin			
Victoria		lark			

English	Dawn	Die	Do	Drink	Ear
Malay	fajer	mati	asu	minum	talinga
Samoa	tafa ata	mate	ulī	inu	talinga
Rarotonga	akirata	mate	kuri	inu	taringa
Maori	atatu	mate	kuri	inu	taringa
Tonga	hegihegi	mate	kuri	inu	telinga
Tahiti	ata	mate	uri	inu	taria
Hawaii	wanaao	make	ilio	inu	pepeiao
Marquesan		mate	moho	inu	puaina
Fiji	mataka thatha	mate	koli	gunuva	dalinga
Malagasy	maso andro	maty	alika	misótro	sofina
Nikunau	naī	mate	kiri	moi	taniñ
Motu	daba e kinia	mate	sisia	inua	taia
D. York	lara	mat	pap	inim	talinga
Lifu	kaqa ne lai	meei	vailai	ij	hnangenyë
Iai	hauolan	mok	kuri	ij	nikonyin
Kanala	nahoig	pāī	umbara	winjo	whanene
Aneityum	nauhoig yi amud	mas	kuri	umnyi	intikgan
Tasmania	tagre maranyé	mientung	kaeeta	lougholee	mungena
South Australia	beerai		boreang	kodo warrang	donga
Kamilaroi		bālūni	būrumā	ngarugō	binna
Victoria		murmbul		nūbuk	winguk
Dippil					binung

Motu is in New Guinea; Iai, one of the Loyalties; Duke of York, near New Britain; *k* is hard *g*; Kanala is in New Caledonia (Mak).

English	Eat	Egg	Evening	Eye	Face	Father
Malay	mākan	tūlor	patang	mata	mūka	ama
Samoa	‘ai	fua	afiafi	mata	mata	tamā
Rarotonga	kai	ua	aiai	mata	mata	metua tane
Maori	kai	hua	ahiahi	kanohi	mata	matua tane
Tonga	kai	foi moa	ifiafi	mata	mata	tamai
Tahiti	amu	huero	ahiahi	mata	mata	matua tane
Hawaii	ai	hua	ahiahi	maka	ka maka	makua kane
Marquesan	ai	mamai	ahiahi	mata	mata	motua
Fiji	kana	yaloka	yakavi	mata	mata	tama
Malagasy	homana	atody	hariva	maso	tarehy	ray
Nikunau	amarake	buñ	kairiki	matana	mata	tama
Motu	ania	katoi	adorahi	mata	vaira	tamana
Duke of York	ani	kiau	malurap	mata	mata	tama
Lifu	chen	nekŏi gutu	hej	mek	ialamek	kem
Iai	an	whakun	sahac	emakang	nimakan	kamen
Kanala	ndra	khondro		kereme		panēre
Aneityum	caig	naklin ja	nepig	nesganimtan	nesganimtan	etman
Tasmania	tughlee		kaoota	mongtena		nunalmina
South Australia	nangur		būlului	mil		kyne-kur
Kamilaroi	tāli	ko	būlului	mil		bubā
Dippil	kidnongatha			mi		bobbin
Victoria	thang garth			mirinjatha		marmunth

The Australian words (except Kamilaroi) have been spelt after Capt. Cook's plan—after the sound of English letters.

English	Feather	Female	Fire	Fish	Flower
Malay	bulu	betina	api	ikan	bunga
Samoa	fulu	fafine	afi	i'a	funga
Rarotonga	uru	vaine	a'i	ika	pua
Maori	hou	wahine	ahi	ika	pua
Tonga	fulu	fafine	afi	ika	kakalafiti
Tahiti	huruhuru	vahine	ahi	i'a	tiare
Hawaii	hulu	wahine	ahi	ia	pua
Marquesan	huu	vehine	ahi	ia	tiae
Fiji	lawe	yalewa	bukawaqa	ika	sē
Malagasy	volomborona	vavy	afo	hazandrano	vonin kuzo
Nikunau	buraena	aine	āi	ika	ue
Motu	hui	haine	doua	qarume	au huahua
D. York	lakua	wawina	ungan	ian	punupu
Lifu	pene	fö	eë	i	engenesinö
Iai	leunen	momo	meic	woa	vongon
Kanala			ne'	no'	
Aneityum	nalau	atahig	incap	numu	intisian
Tasmania			tonna	mungunna	
South Australia			kalla	bee	
Kamilaroi	gūndīr		wī	guiya	guren
Victoria			winth		
Dippil			gira		

English	Fly	Food	Foot	Fowl	Fruit	Go
Malay	lango	makān an	ai	manu	bua	fanow
Samoa	lango	meà'ai	vae	moa	fua	alu
Rarotonga	rango	kai	tapu ae	moa	ua	aere atu
Maori	rango	kai	waewae	tikaokao	hua	haere
Tonga	lango	meakai	vae	moa	fua	alu
Tahiti	ra'o	amu te maa	avae	moa	huero	haere
Hawaii	nalo	he ai	wawae	moa	hua	hele
Marquesas	tiaue	kai	vaevae	moa		
Fiji	langō	kakana	yava	toa	vua	lako
Malagasy	lahtra	hanina	tongotra	akoho	voan kozo	mandehana
Nikunau	naño	bai te amarake	waena	moa	ua	nako
Motu	lao	malamala	ae palapala	kokorogu	āu huahua	lao
D. York	lang	nian	kaki	kereke	ua	wan
Lifu	neng	a ; xen	waca	gutu	wene sinö	trojė
Iai	neng	han	niu-can	khoto	wan	he
Kanala	na'		parī	ndro		fe'
Aneityum	inlag	nitai caig	neduon	inman	nohwan	apan
Tasmania	mongana	luggana				tawe
South Australia	nurdu	dinna				berda
Kamilaroi	būrulū	jeena	dinna	kulgoï	ngaiban	
Dippil			jinnung			
Victoria			jinongatha			hee

English	Good	Great	Hair	Hand	Head	Heaven
Malay	fia	besar	folo	lima	ulu	langit
Samoa	lelei	tele	lauulu	lima	ulu	langi
Rarotonga	meitaki	rai	rauru	rima	upoko	rangi
Maori	pai	rahi	huruhuru	ringaringa	upoko	rangi
Tonga	lelei	lahi	loulu	nima	ulu	langi
Tahiti	maitai	rahi	huruhuru	rima	upoo	ra'i
Hawaii	maikai	nui	hulu	lima	poo	lani
Marquesan	meitai	nui	ouoho	ima	upoo	ani
Fiji	vinaka	levu	vulua	liga	ulu	lomalagi
Malagasy	tsara	lehibe	volo	tanana	loha	lamtra
Nikunau	raoi	bubuua	irana atuna	baina	atuna	karaba
Motu	namo	bada	hui	ima palapala	qara	guba
D. York	lelei	ngala	weu	lima	lori	langit
Lifu	loi	atraqat ; tru	pene	iwanakoim	he	hnengödrai
Iai	so	gan	leunen	nijam	ban	dran
Kanala	khoru	amunyendro	pumba	merekhe	mbwa	nekhwawa
Aneityum	upene	alupas	numrin	nikman	nipek	nohatag
Tasmania	kekanna		poinglyena	riena	ulumpta	peuniac
S. Australia	gwabba		mugar	mara	kata	kallaruk
Kamilaroi	muruba	būrul	tegul	murra	ga	gūnakulla
Dippil			dhella	duruin	kām	
Victoria	talkuk	detarbul	yarragongatha	munangin	kowong	būruru

English	House	Kill	Leaf	Man	Mosquito	Mother
Malay	rumah	bunoh	laun	tomata	nymok	inana
Samoa	fale	fasi	lau	tangata	namu	tinā
Rarotonga	are	tamate	rau	tangata	namu	metua vaine
Maori	whare	whakamate	rau	tangata	waeroa	matua wahine
Tonga	fale	tamate	lau	tangata	namu	fae
Tahiti	fare	taparahi	rau	ta'ata	namu	matua vahine
Hawaii	hale	pepehi	lau	kanaka	namu	makua hine
Marquesan	fae	pehipehi	au	enata		ui
Fiji	vale	vakamate	drau	tamata	namu	tina
Malagasy	trano	mamono	ravina	lehilahy	moka	reny
Nikunau	uma	tiriña	rau	aomata	maninara	tinana
Motu	ruma	alaia	rau	tauna	namo	sinana
D. York	ruma	umi	kilai	muana	namu	na
Lifu	uma	humuth	dröne	at	tresit	thin
Iai	uma	linga	lan	at	mina	hinyen
Kanala	'ma	soame'	nere	khōtro	no'	amunyiere
Aneityum	neom	atgei	nerin	natimi	inyum	risin
Tasmania	lenna	mienemiento		pugganah		neingmena
S. Australia	mier	kidjenangur			nirgo	eiya
Kamilaroi	kūndi	balubuma	karril	giwir	mūngin	ngumba
Victoria		jaalburt		kūlinth		parbine
Dippil	durabunnu	baigin		dān		ngavang

English	Mountain	Mouth	Night	Nose	Rain	Rat
Malay	gunong	nuku	bungi	iru	uan	tikus
Samoa	maunga	ngutu	po	isu	ua	imoa ; iole
Rarotonga	maunga	vaa	po	putaiu	ua	kiore
Maori	maunga	waha	po	ihu	ua	kiore
Tonga	mounga	ngutu	pouli	ihu	uha	kuma
Tahiti	mou'a	vaha	po	ihu	ua	iore
Hawaii	mauna	waha	po	ihu	ua	iole
Marquesas	mouna	vaha	po	ihu	ua	kioe
Fiji	ulunivanua	ngusu	bongi	uthu	utha	kalavo
Malagasy	tendrombohitra	vava	halina	orona	ranonorana	voalavo
Nikunau	mauñ	wui	boñ	bairina	karau	kimoa
Motu	orooro	udu	hanuaboi	ndu	medu	bita
D. York	tagai	wa	marum	ngingiro	bāta	kaupwa
Lifu	wetr	që	jid	hnafij	mani	aji
Iai	bujen	nimen	lit	bàhoin	wē	tep
Kanala	bwākwe	nekwa	mo'	kuni	kwie	sīmbu
Aneityum	nau	neucsen	nepig	ingidjin	incopda	incedo
Tasmania	poimena	kakanina	tagrumena	mununa	pokana	lyinganena
S. Australia	kubba	da	katteek	mulya		
Kamilaroi	kubba	ille	ngūrū	mūrū	yuro	kimma
Victoria	ngorak	worongatha	buronthuith	congatha		
Dippil	waiker	tunka		mūrū		

English	Road	Root	Sea	Sit	Skin	Sleep	Small
Malay	dara	akar	Tahi	dūduk	lilicolo	tidor	kiiti
Samoa	ala	a'a	tai	nofo	iliola ; pa'u	moe	itiiti
Rarotonga	ara	aka	tai	noo	kiri	moe	iti
Maori	ara	pakiaka	tai	noho	kiri	moe	iti
Tonga	hala	aka	tahi	nofo	kili	mohe	ti (ji)
Tahiti	ara	a'a	tai	noho	iri	moe	iti
Hawaii	ala	a'a	kai	noho	ili	moe	iki
Marquesan	aanui	aa	tai	noho	iri	moe	nainai
Fiji	sala	waka	tathi	tiko	kuli	mothe	lailai
Malagasy	lalana	laka	ranomasina	mipetraka	hoditra	matory	kely
Nikunau	karai	waka	tari	tekateka	baka	matu	irariki
Motu	dara	ramuna	davara	hela	kopaia	mahuta	maragi
D. York	akapi	akara	tai	ki	pi	inep	kinalik
Lifu	gojeny	wan	lnagejë	lapa	kupein	meköle	co
Iai	gethen	iwan	koia	laba	unen	mokut	inukong
Kanala	whai		kwetra	eue	kore	metu	khundro
Aneityum	efalaig		injap	ateuc	narasin	umjeg	haklin
Tasmania		reminye	liennawuttya	mealpugha	tara minya	lony	
S. Australia	beda		murrian		mobp	bidjar	
Kamilaroi	turabul			ngudella	yūli	bābi	kai
Victoria			warrain			umina	wanimuk
Dippil						mibon	

English	Smoke	Spirit	Stand	Star	Stone	Storm
Malay	asap	niawa	tegga	fatui	batu	tufan
Samoa	asu	agaga	tu	fetu	fatu	afā
Rarotonga	auai	vaerua	tu	etu	toka	aa
Maori	auahi	wairua	tu	whetu	toka	pokaka
Tonga	ahu	laumalie	tu	fetu	maka	afā
Tahiti	auahi	varua	tu	fetu	toa	vero
Hawaii	uahi	uhane	ku	hoku	pohaku	ino
Marquesan	auahi	uhane	tu	fetu	kea	
Fiji	kubou	yalo	tu	kalokalo	vatu	thava
Malagasy	setroka	fanahy	mitsangana	kintana	vato	tafro-drivotra
Nikunau	bubu	tamunei	tei	itoi	atibu	age ae korakora
Motu	qalahu	lauma	gini	hisiu	nadi	guba
D. York	mi	nio	turu	nangnang	wāt	pakan talā
Lifu	haj	u	eil	wëtesij	etë	wené
Iai	hai	hanu	tet	okhu	veto	whenu
Kanala	june	kwèri	tra	sueme	sange	
Aneityum	nadranеap	nesgan	aiji	inmoijeuv	inhat	neihio
Tasmania	progoona	warawena		teahbranna		poimetya
South Australia	booya	nganya		milyarn		tulumi
Kamilaroi	du	wunda	warine	mirri	yārul	
Victoria				turt	lar	
Dippil				whycurl		

H	English	Sun	Thunder	Tongue	Tooth	Tree	Water
	Malay	laci	guruh	lilah	nifoa	puhn	wai
	Samoa	la	faititili	alelo	nifo	laau	vai
	Rarotonga	ra	mangungu	arero	nio	rakau	vai
	Maori	ra	whatitiri	arero	niho	rakau	wai
	Tonga	laa	mana	elelo	nifo	akau	vai
	Tahiti	mahana	haruru	arero	niho	raau	vai (pape)
	Hawaii	la	hekili	alelo	niho	kumulaau	wai
	Marquesas	oumati	fatutii	eeo	niho	kaau	vai
	Fiji	siga	kuru	yame	bati	kau	wai
	Malagasy	masoandro	kotrokorana	lela	nify	hozo	rano
	Nikunau	tāi	kabuariki	nove	wi	kai	rani
	Motu	dina	gubarahua	mala	hise	au	ranu
	D. York	make	pakpakuru	karamenawa	lako	diwai	palā
	Lifu	jö	hedrengi	thinem	nyö	simö	tin
	Iai	seuno	than	bomen	niön	uto	koia
	Kanala	kamia			pa'	kwa	kwe
	Aneityum	nagesega	inmunuka	naman	neijin	incai	inwai
	Tasmania	pugganoobra-nah		kayena			
	South Australia	yarai			wugrina	loatta	liena
	Kamilaroi	yarai	tulumi	dakondail	nalgo	boona	kolle
	Victoria	yarrh	murndell	tulle	yīra	tulu	kolle
	Dippil		mumba	talanyak	leongatha		kallingi
							kōng

English	Weep	Wife	Wind	Woman	One	Two	Three
Malay	tangis	sawa	angin	bawine	sa	lua	tolu
Samoa	tangi	avā	matangi	fafine	tasi	lua	tolu
Rarotonga	aue	vaine]	matangi	vaine	okotai	rua	toru
Maori	tangi	wahine	matangi	wahine	tahi	rua	toru
Tonga	tangi	ohana	matangi	fafine	taha	ua	tolu
Tahiti	tai	vahine	matai	vahine	tahi	piti	toru
Hawaii	uwe	wahine	makani	wahine	kahi	lua	kolu
Marquesas	aue	vehine	matani	vehine	tahi	ua	tou
Fiji	tangi	wati	thangi	alewa	dua	rua	tolu
Malagasy	mitomany	vady	rivotra	vehiravy	isa	roa	telo
Nikunau	tag	buna	ag	aine	teuana	uaua	tenua
Motu	tāi	adavana	lāi	haine	tamona	rua	toi
D. York	luan	tebuan	dadaip	tebuan	ra	rua	tul
Lifu	teij	ifënekö	enyi	fö	cas	luete	könite
Iai	tengi	aian	ang	momo	khaca	lo	kun
Kanala	tei	kwēre	kwondre	se‘	sa	mbāru	mbasi
Aneityum	taig	ehgan	nimtinjap	intakata	ethi	ero	eseij
Tasmania	tagaramena	kroatalanganya	rawlina	lowanna	marrawah	pia wah	lea winawah
S. Australia	mira	yuggow	maier	eiya	gain	good-jal	njar-ril
Kamilaroi	yūgila	gulir	maier	yīnar	māl	būlār	gūliba
Victoria		marrarbuk	mormmut	bagaruk	kiarp	bullait	bullait par kiarp
Dippil		yīrum		yirum			

English	Four	Five	Six	Seven	Eight	Nine	Ten
Malay	faa	lima	onomo	fitu	walu	siwa	sapuloh
Samoa	fa	lima	ono	fitu	valu	iva	sefulu
Rarotonga	a	rima	ono	itu	varu	iva	ngauru
Maori	wha	rima	ono	whitu	varu	iwa	ngahuru
Tonga	fa	nima	ono	fitu	valu	hiva	ongofulu
Tahiti	acha	rima	ono	hitu	vau	iva	ahuru
Hawaii	ha	lima	ono	hiku	walu	iwa	umi
Marquesas	fa	ima	ono	fitu	vau	iva	umi
Fiji	va	lima	ono	vitu	walu	thiwa	tini
Malagasy	efatra	dimy	enina	fito	valo	sivy	folo
Nikunau	aua	nimaua	onoua	itua	waniua	ruaua	tebuina
Motu	hani	ima	tauratoi	hitu	taurahani	taura hanita	qauta
D. York	wat	lima	nomdi	limadi ma ruadi		limadi ma tuldi	no
Lifu	ekete	tripi	cangemene	luengemen		ekengemen	luepi
Iai	vak	benyin	thabung ke nua khaca	thabung ke nualo			libenyita
Kanala	kenefue	kerenunu	kerenunu sa	kerenunu mbaru			drusēkhe
Aneityum	emanowan						
Tasmania	pagunta	pugana					
S. Australia							
Kamilaroi	bularbular	mulanbu	malmulanbu-mumi	bularmulanbu mumi			
Victoria	bullaitbullait						
Dippil							

English	I	Thou	He	We	You	They
Malay	aku	kau	iya	kita	kan	kalatou
Samoa	a'u	'oe	ia	tatou	outou	koulatou
Rarotonga	au	koe	aia	tatou	koutou	koulatou
Maori	au	koe	ia	tatou	koutou	kouratou
Tonga	au	koe	ia	tautolu	kimoutolu	kouratou
Tahiti	vau	oe	ia	tatou	outou	kouratou
Hawaii	au	oe	ia	kakou	oukou	oulakou
Marquesas			koya	tatou	otou	kouratou
Fiji	au	iko			kemuton	kedratou
Malagasy	aho	irery	ïnaia	izy	hianao	izy
Nikunau	ïai	ïkoe	ia	ïaira	ïkami	ïdia
Motu	lau	oi	ia	ai	umui	ladia
D. York	iau	ui	ia	dat	muat	dadiat
Lifu	ini	eö	angeic	eëshë	nyipunic	angatr
Iai	inya	u	e	otin	obu	nodru
Kanala	gu	ge	weia	imi	ngumi	ngodrumi
Aneityum	ainyak	aiek	aieu	akaija	aijana	ngara
Tasmania	mina				neena	
S. Australia	ngimee	ngaiatha	bal	ngan-ne	nurang	ngalgoon
Kamilaroi	ngaia	nginda	ngerma	ngeane	ngindai	ngarma

Discussion.

The following notes have been furnished by Mr. J. F. Mann :— I have no means of my own of comparing this list of words with the language used by the aboriginals of New South Wales ; copious vocabularies which I made years ago have long since been lost ; I am from other sources, however, enabled to supply a considerable list of words used by natives of at least four of the tribes of South Australia. It will be observed that in no instance do the words given by the Rev. Mr. Pratt under the heading of "S. Australia" agree with the accompanying list. This may be accounted for by the following reason : A custom prevails among the aboriginals of naming a child after the first living object seen by the mother or nearest relative at or immediately after its birth ; thus, a bird, butterfly, reptile, &c., &c., each afford a name for the youngster, and this name holds good until the child, if a male, becomes a young man, when he has to submit to many very painful operations and extraordinary ceremonies in order to enable him to take his place among the warriors. At that time he receives another name, also derived from some animal or vegetable, or in reference to some incident worth recording. Should this man die, such is the objection to repeat the name that another word has to be coined to represent it. Jealousy between tribes often prevents the mutual use of a word ; so that in forming vocabularies each tribe has to be closely questioned as to the proper word, and even then much discretion must be observed, as the natives do not like to be cross-questioned ; so unless you are thoroughly in their confidence you are likely to be misled.

The pronunciation has to be closely noted ; thus, one reverend missionary records that he had resided a length of time with a tribe before he discovered that the words *sin* and *thin* had been confused, consequently these poor blacks thought that a thin person had no chance of going to heaven, and took great trouble to cram and fatten up all whom they thought worthy of salvation.

My authority for the accompanying list are the Rev. G. Taplin, Rev. Mr. Teichelman, Mr. Moorehouse, Rev. Mr. Schurman (South Australia) ; Mr. J. Gason, Cooper's Creek, Dieyerie Tribe ; Mr. J. W. O. Bennett, Northern Territory.

List of some words used by the natives of South Australia :—

English	Ashes	Back	Bad	Belly
Brisbane Water, Hawkesbury*	tweelerah			
Lake Alexandrina			wirringi, brupi	
Adelaide, S.A.		ngooroo	wakkina	moonto
Lower Murray			payu	
Port Lincoln			milla, nangk	
N. Territory			wŏd-lleker	
Cooper's Creek		thookoo		

English	Bird	Black	Blind	Blood	Body
Lake Alexandrina				kruwi	
Adelaide, S.A.		boolyŏn, innemin	paichōte ; katpatte	karoo or kurro	
Murray River, S.A.				kantur	
Port Lincoln				kartintye	
Cooper's Creek	piya	muroo	bootchoo	koomarie	nindrie—body of anything
N. Territory		lō-ar-kĕ-ĕng-ĕr		mūm-al-wăr	

English	Bone	Born	Breast	Butterfly	Chief
Adelaide, S.A.			umme		
Cooper's Creek	mookoo; yaniekaitcha		auma		
N. Territory					yūr-yĕr-wŏng-â-lăy-wūck-ĕr
Bathurst			berrin		

English	Child	Cloud	Come	Dark	Day
Lake Alexandrina		tuppathauwe			nunggi
Adelaide, S.A.		†makko, naiāra	konaie	boolyoreende	tindo, teendo
River Murray, S.A.		ngernke			nort
Port Lincoln		mabingi malko			wallira marka
Cooper's Creek	koopa		kapara	milyaroo	
N. Territory			bŭrrŏ-qui-tŏ		
Hawkesbury					buneye—to-day, now, at present

* A name given for flour and bread. † Cloud, also Tippadoua,

English	Dawn	Die	Dog	Drink	Ear
Lake Alexandrina		pornum	wanbi keli		plombi
Adelaide, S.A.	Teen do tokoocha	mulleene ; madlendi	kadli ; warro kadle	narkone ; narkoonde ; mootooramboona	yure ; yureilla ; lumbangge
River Murray, S.A.		puintyum	kellu		marlo
Port Lincoln		madlentitti	kurdninni		
Cooper's Creek	thinkabooroo		kintalo		cootchara
N. Territory					wal
Hawkesbury			worrigul		
Bathurst (native)			miree		woota

English	Eat	Egg	Evening	Eye	Face	Father
Lake Alexandrina				piili		
Adelaide, S.A.	paiyáne ; mootan ; moka ; pōmbe mootaine ; tarkun		teendoatpan or atpände, karkalo	mena		ngaiyeri ; terroo yerlimeyer
River Murray, S.A.				korllo		ngukkuwan ; petuwurra
Port Lincoln				mena		pappi
Cooper's Creek	tiami ; tiala	kuppie				apinie ; apirrie
N. Territory		lŏngmâ		mâ		pēp-pee
Hawkesbury	tchowa					

English	Feather	Female	Fire	Fish	Flower
Lake Alexandrina		mimine (woman)	keni	mami	
Adelaide, S.A.	yornde, ngarro	tuk ku perka ; ngammamitya ungkeeto	gadla ; peea	pamdo ; kooya, kooye, or kooyoo	
River Murray, S.A.		ngamaityu	kappangko	kuyongo	
Port Lincoln		ngamaityu	gadla	kuya	
Cooper's Creek		widla (woman)	thiewie	kurumba	
N. Territory			lee-tŭn-gĕr	lĭyer	
Hawkesbury		nugong (woman)	kweeong		

English	Fly	Food	Foot	Fowl	Go
Adelaide, S.A.	cheele (common fly)	may-maya (food, not flesh)	turni		
Cooper's Creek	mooncho	booka (vegetable food)	thidna		
N. Territory	lŭng-oi-tĕr	mummer (food generally)	ummâl	loo-wār-im-e	Gŭin-ee, berroque

English	Good	Great	Hair	Hand	Head	Heaven
Lake Alexandrina	nunkeri	grauwi	kuri	mari	kurli	wyirrewarre
Adelaide, S.A.	marni ; mane ; marno	parto		marra	mukarta	karro
River Murray, S.A.	midlaityo ; mendilpa	yernko ; worpippi	yengku	mannuroko	pertpukko	
Port Lincoln	marniti	manna		murra	kakka	pandari ; ilkari
Cooper's Creek	omoo	moolaroo ; marpoo ; pina	para	murra	mongathanda	purriewillpanie
N. Territory			lĕr-māl-nĕr	mân-ĕnee	mŭdlŏ	
Bathurst			ketar		pallang	
Hawkesbury	maron—well, enough, stop, "belay"					

English	House	Kill	Leaf	Man	Mosquito	Mother
Lake Alexandrina	werle ; manti			korni		ninkowe
Adelaide, S.A.	werle ; munde ; wodli	toorla	teenjo	meya ; meyu	kointa-paicha	ngankimeyie
River Murray, S.A.	rap			meru		ngakur ; ngauwar
Port Lincoln	karnko			yura		ngammi
Cooper's Creek	boonga			matharie	koontie	andrie ; andrie
N. Territory	wylee			mē-àng-ĕn-er	moong-oor-oong-ĕr-ĕr	kadee
Hawkesbury, Brisbane Water		piela		karambala (white man)		

English	Mountain	Mouth	Night	Nose	Rain	Rat
Lake Alexandrina		tori	yonguldyi	kopi	parnar	
Adelaide, S.A.	ngoorle (a hill)	ta	ngulti		kuntoro	
River Murray, S.A.		munno ; taako	nimmi	roonko	bukatarru	
Port Lincoln		narparta	malti		wirra	
Cooper's Creek		muna	pulkara	moodla	thulara	miaroo
N. Territory	lil-yer-wĕr (a hill)		mē-mâ-kē	wee-yĕhr	mŏrnee	
Bathurst		**nang**		**moro**		

English	Road	Root	Sea	Sit	Skin	Sleep	Small
Lake Alexandrina			yarluwar	lewin			muralappi
Adelaide, S.A.			yerlo, koopoola, koue	lāwin, tinkandi		meeroo	kutyo
River Murray, S. A.			terlungo	woimangko			poilyongko
Port Lincoln			wortanna	lkkata			perru
Cooper's Creek				aamami	kilehami, to skin	mooka	waka waka
N. Territory				loorl		wĕ-a-qua	
Hawkesbury			mullaeullama ; **also, soapsuds**				me-et-meker

English	Smoke	Spirit	Stand	Star	Stone	Storm
Lake Alexandrina				tulde	marte	
Adelaide, S. A.	káre ; moorlde ; **yitpe, pooĕyoo, pooĕya**			poorle ; purle ; **waiere ; tooltar**	pure ; koree	
River Murray				**pedli**	**parlko**	
Port Lincoln			tharka ; tharkami		kanya	
Cooper's Creek	yookardie	mooramoora **good spirit** **kootchie** **evil spirit**		ditchiethandra-**wauka ; amathoorooccooroo, evening star**		
N. Territory				mŏ-il-wer		

English	Sun	Thunder	Tongue	Tooth	Tree	Water
Lake Alexandrina	nungge		tallangi	turar	lamatyeri	nguk ; barekar
Adelaide, S. A.	tindo		tadlanya		wirra	kauwe ; ngoke
River Murray	nangke		ngantudli	ngentka	perru	ngukko, kone
Port Lincoln	yurno		tarli		idla	kapi kano
Cooper's Creek		thulurayindrie				apa
N. Territory	ummee	lēur-wee		yā	meakul	e-â-ki
Bathurst				erang		
Hawkesbury	bunyell					

English	Weep	Wife	Woman	One	Two	Three
Lake Alexandrina		napi	mimine	yammalaitye	ninkaiengk	neppaldar
Adelaide, S. A.	ngeeranniek ; kokareen	karto ; ummaiche ; yoongara ; yangara	tukkupurka ; ngamamitya : ungke ; ungkeeto ; warke	kuma ; koma ; komante	purlaitye ; neengau ; neengauge	marnkutye ; multar
River Murray, S. A.		loangko	ngammaityu	metatta	tangkul	kokerkeer 2 + 1 ; murnkoche ; napullar ; napullyar
Port Lincoln		karteti	ngammatyu	kuma ; kubmanna	kalbelli ; kattara	tangul meto
Cooper's Creek		noa (or husband)	munkara (young woman)	koorno	mundroo	kullbarri
N. Territory		mūng-ĕd-mā	ween-been-ĕr	tēl-ling-it-er	tōlloiyĕr	parkooloo

English	Four	Five	Six	Seven	Eight	Nine	Ten
Lake Alexandrina	kuk kuk						
Adelaide, S. A.	yerrabula ; koker koker ; 2 + 2	kōk kok keer ; 2 + 2 + 1					
River Murray	nailko						

English	I	Thou	He	We	You	They
Lake Alexandrina	ngap	nginte	kitye	ngurn	ngun	kar
Adelaide, S.A.	ngai ; anawe	ninna ; omāwe	pa ; kinnawe	ngadlu ; kérnăwe	na	parna ; kernaiche
River Murray	ngape	ngurrei	nimni	ngennu	ngunnu	nana
Port Lincoln	ngai	ninna	panna	ngarrinelbo	nuralli	yardna
Cooper's Creek	althoo	yondroo	noolica	uldra ; iannana barley	yinie	thana
Hawkesbury	naghtoir	ningtoir				
N. Territory	ung-goingee		o-win gee	uug-goin-gee	ne-tan-gee	

Preliminary notes on some new Poisonous Plants discovered on the Johnstone River, North Queensland.

By T. L. 'Bancroft, M.B., Edin., F.L.S.

(Communicated by Prof. T. P. Anderson Stuart, M.D.)

[*Read before the Royal Society of N.S.W., 2 June, 1886.*]

Among many barks, leaves, and fruits collected on the Johnstone River during 1885, with a view to ascertain if they possessed any physiological activity, was the bark of a small tree called *Daphnandra repandula*, F. v. M., of the order *Monimiaceæ*, which possesses a somewhat bitter taste.

This bitter property exists in all parts of the plant.

Extract of the bark was prepared in August, 1885, and experiments instituted the following October.

A grain or more of alcoholic extract suspended in a few minims of water injected under the skin of guinea-pigs asphyxiates them rapidly, but with smaller doses they sometimes recover.

As a rule if animals live for half an hour they ultimately recover.

The following symptoms may be observed when a grain of the alcoholic extract suspended in five minims of water is injected under the skin of a guinea-pig, death taking place within half an hour :—

The animal becomes at first very restless and eats with avidity, but this continues only a few minutes, and is probably due to the irritation of the injection. As soon, however, as the animal quietens down, convulsive twitches of the extremities, and afterwards of the whole body, occur every second or two, but they are not of a violent kind, and continue until death. The eyelids blink in a curious way occasionally, respiration is increased, and the front legs are no longer able to support the body ; the animal in consequence rests upon its chest. This condition is very characteristic, and is an almost certain sign that the dose has been a fatal one.

The animal up to this time could exercise voluntary movements. The hind legs next become weak, and if the animal be now placed upon its back, it is no longer able to right itself, although there yet remains power of movement in all the limbs; it is perfectly

sensible to pain. Soon, however, complete paralysis of the whole muscular system takes place, the animal dying asphyxiated. Violent contractions of the facial muscles are the last apparent sign of life; but the heart in some cases beats on slowly for a few minutes; *rigor mortis* rapidly ensues.

I conclude, from experiments made upon cats, guinea-pigs, frogs, and grasshoppers,—

1. That this poison paralyses the motor nervous system.
2. That it does not affect sensory nerves.
3. That it is not a muscle poison.

The same poisonous property exists in *Daphnandra micrantha*, Benth., and in a new species called "aromatica," discovered on the Johnstone, and so named by my friend Mr. F. M. Bailey on account of its aromatic taste and smell resembling Sarsaparilla.

B.—*Archidendron Vaillantii*, F. v. M., a leguminous tree, attracted attention by its conspicuous pods, containing beans of a black colour and nauseous hot taste. The bark is also hot and acrid.

Alcoholic extract of the dried bean was made, five grains of which, suspended in a few minims of water, were injected under the skin of a kitten, which died asphyxiated in a few hours.

The bark was found to be more poisonous than the bean or leaves.

Guinea-pigs poisoned with this substance have painful convulsive movements of the whole muscular system, increasing in frequency and force as the poison gets absorbed. The hind legs become paralysed, and the animals lie in a helpless state for many hours before they die, and utter feeble cries when moved about. After death the muscles contract when cut across, or when stimulated through their nerves up to their exit from the chord.

Neither the motor nor the sensory nerves seem to be affected.

This substance kills by paralysing the reflex function of the spinal chord.

C.—*Pongamia glabra*, Vent., a tree of the order *Leguminosæ*, contains in all parts of the plant a principle of considerable activity as an emetic.

Frogs poisoned with extract of the bark vomit for several hours, after which they become torpid, and generally die within forty hours.

D.—*Zanthoxylum veneficum*, Bail., a small tree of the order *Rutaceæ*, being a new species discovered in August, 1885. The bark possesses a peculiar tingling hot taste like aconite. The plant was specifically named "veneficum," in consequence of its poisonous property, by Mr. Bailey.

Two other species of *Zanthoxylum*, viz., *Z. torvum*, F. v. M., and *Z. brachyacanthum*, F. v. M., and probably others of the same genus are likewise poisonous.

Numerous experiments were made with extract of the bark of this tree upon dogs, cats, rats, frogs, and grasshoppers.

It acts upon the spinal chord, increasing the reflex excitability, and finally paralysing the chord.

It poisons grasshoppers, while strychnine has no action upon them.

It tetanises frogs, even when applied to the skin.

In its physiological action it resembles strychnine.

The following may be taken as a typical example of the effect of this substance upon warm-blooded animals :—

Four grains of the alcoholic extract suspended in five minims of water and five of spirit were injected under the skin of a large cat. Immediately afterwards the cat was uneasy, would lie down, then raise itself, walk a little, and lie down again. In eighteen minutes a tremor of the ears and head was noticed, the pupils were dilated, locomotion was affected ; the animal could only walk a yard or so in a stiff, awkward way. In twenty minutes the tremors were frequent, and power to walk almost gone. In thirty minutes there were convulsive contractions of the fore limbs and muscles of chest ; a strong light would not alter the iris. In thirty-three minutes the lips were livid, and tetanic convulsions commenced ; during one of these attacks the respiration is very laboured, inspiration stertorous, the head hangs down, and the cat jerks itself backwards ; directly after the spasm goes off the cat lies down exhausted. In forty-five minutes there was a tetanic spasm every minute, and the animal was expected to die every convulsion. In fifty-five minutes tetanic spasms last about a quarter of a minute ; inspiration extremely laboured and prolonged, with wheezing ; at times no air can be inspired, and the chest becomes collapsed. In sixty minutes the cat jumped and fought for breath in a frightful way, and died ; the heart could be felt to beat regularly for two minutes afterwards. Four hours after death there was *rigor mortis*, the right side of the heart was empty, and the left ventricle firmly contracted ; the intestine was bloodless and contracted.

With larger doses than five grains tetanic spasms come on rapidly, and the animals die in a few minutes.

Large dogs recover sometimes after five grains have been injected under their skin.

Metallic Meteorite, Queensland.

By A. Liversidge, F.R.S., Professor of Chemistry in the University of Sydney.

[*Read before the Royal Society of N.S.W., 2 June, 1886.*]

Preliminary Notice.

This meteorite was found at Thunda, Windorah, in the Diamantina district, Queensland, and was kindly lent to me for examination by Mr. C. S. Wilkinson, F.G.S., Government Geological Surveyor of New South Wales.

Mr. Wilkinson was informed that this specimen was broken off a larger mass weighing a hundred weight or more, and it certainly has every appearance of having been recently detached. The large piece is said to be buried about 4 inches in the ground, and the natives had covered it with stones, so that they evidently regarded it as something of importance or value. The weight of the fragment was 258·7 grammes, and its specific gravity was found to be 7·77 at 16° C, being the mean of two determinations made on separate pieces, viz., 7·75 and 7·79. In form it is very irregular, the internal crystallised structure is well shown by the fractured surface, the plates standing out in bold relief and meeting one another at fairly regular angles which are apparently those of the octohedron. In the hollow on one side a distinct pitted structure is seen showing that this apparently formed one of the external surfaces of the meteorite, although the usual well marked skin of fused magnetic oxide is not present.

Up to the present I have not had time to make more than a preliminary qualitative examination, but this shows clearly that this specimen has the usual composition of the metallic group of meteorites. It consists mainly of iron, with nickel, and a trace of cobalt, both sulphur and phosphorus are present, and apparently a trace of carbon, and I think it will be found not to differ materially from the New South Wales meteorite found at Bingera. (*See* Journ., Roy. Soc., N.S.W., 1882, p. 35.)

Further Additions to the Census of the Genera of Plants hitherto known as indigenous to Australia.

By Baron Ferd. von Mueller, K.C.M.G., M.D., Ph.D., F.R.S.

[*Read before the Royal Society of N.S.W., 7 July, 1886.*]

Pyenarrhena, Miers in Ann, and Magaz, of nat. hist. set. ser. VII, 37 (1851); after Pachygone.

Melicytus, R. & G. Forster char. gen. 123, t. 62 (1776); after Hymenanthera.

Ternstroemiaceae, Mirbel in Bull. de la Soc. philom. 381 (1813); after Guttiferae.

Sarauia, Willdenow in Schrift. naturf. Freunde zu Berlin III, 406, t. 4 (1801).

Herniaria, Tournefort inst. rei herb. 507, t. 288 (1700); after Seleranthus.

Dipteranthemum, F. v. M. in Wing's South. Science Rec. III, 281 (1884); after Ptilotus.

Cyathula, Loureiro fl. Cochinchin. I, 101 (1790); after Amarantus.

Celosia, Linné gen. pl. 34 (1737); after Deeringia.

Cleistocalyx, Blume Mus. bot. Lugd. Bat. I, 84, t. LVI (1849); after Eugenia.

Sphenoclea, Gaertner de fructib. I, 113, t. 24 (1788); after Wahlenbergia.

Argyreia, Loureiro fl. Cochinchin. I, 134 (1790); after Ipomoea.

Labisia, Lindley in Bot. Regist. XVIII, t. 48 (1845); after Ardisia.

Didymoplexis, Griffith in Calcutta Journ. of nat. hist. IV, 383 (1844); after Gastrodia.

Stenotaphrum, Trinius fundam. Agrostogr. 175 (1820); after Xerochloa.

Salvinia, Micheli nov. plant. gen. 107, t. 58 (1729); after Azolla.

Meniscium, Schreber gen. plant. II, 757 (1791); after Grammitis.

Sclerodontium, Schwaegrichen in Hedw. spec. musc. Suppl. II, 124 (1824); after Neckera.

Omphalanthus, Lindenberg & Nees synops. hepatic. 303 (1845); after Phragmicoma.

Bryopteris, Nees Europ. Leberm. III, 211 (1838); after Frullania.

Plagiochasma, Lehmann pugill. plant. IV, 13 (1832); after Marchantia.

Alectoria, Acharius lichenogr. univers. 120 (1810); after Evernia.

Theloschistes, Norman Conat. redact. nov. gen. lich. 16 (1852); after Parmelia.

Lecania, Massalongo Aleun. gen. di Lichen, 12 (1853); after Lecanora.
Ocellularia, G. Meyer Entwickl. der Flecht. 327 (1825); after Thelotrema.
Arthonia, Acharius in Schrad. neu. Journ. fuer Bot. I, 3 (1806); after Graphis.
Glyphis, Acharius synops. lichen. 106 (1814); after Graphis.
Trypethelium, Sprengel Anleit. in das Stud. kryptog. Gew. 350, t. 10 (1804); after Verrucaria.
Radulum, Fries plant. homon, 81 (1825); after Hydnum.
Laternea, Turpin icon. champ. fig. 2 (1820); after Clathrus.
Phyllosticta, Persoon Champ. comest. 55 (1818); after Phoma.
Sphaeropsis, Leveillé in Annal. des sc. nat. trois. sér. III, 62 (1845); after Phoma.
Alelophia, Saccardo syllog. fung. III. 658 (1884); after Phoma.
Actinonema, Persoon mycol. Europ. I, 51 (1822); after Phoma.
Chaetophoma, Cooke in Grevillea III, 25 (1874); after Phoma.
Gamospora, Saccardo & Berlese in Rev. mycol. (1885); after Phoma.
Actinothecium, Cesati in Hedsvigia I, t. XI. fig. 3 (1852); after Excipula.
Pestalozzia, Notaris micromyc. Ital. II, t. 9 (1842); after Excipula.
Erineum, Persoon observ. mycol. I. 99 (1796); after Cladosporium.
Fusicladium, Bonordon Handb. der Mykol. I, 80 (1851); after Cladosporium.
Podosporium, Schweinitz in trans. Amer. Phil. Soc. IV. t. 19 (1832); after Helminthosporium.
Capnodium, Montagne in Annal. des. sc. nat. trois. sér. XI, 283 (1848); after Antennularia.
Hysterographium, Corda icon. fung. V, 34 t. 9 (1842); after Hysterium.
Tryblidiella, Saccardo syllog. fung. II, 757 (1883); after Hysterium.
Rythysterium, Spegazzini fung. Argent. IV n. 191 (1882); after Hysterium.
Phyllachora, Nitschke in Fuck. symbol. mycol. 216 (1875); after Cordyceps.
Lembosia, Leveillé in Annal. des sc. nat. trois. sér. III, 58 (1845); after Asterina.
Sphaerotheca, Leveillé in Annal. des sc. nat. trois. sér sc. XV 128 (1851); after Asterina.
Micropeltis, Montagne in Annal. des sc. nat. sér. sec. XVII, 122 (1842); after Hypocrea.
Hyponyce, Fries plant. homon. 105 (1825); after Hypocrea.
Anthostoma, Nitschke, Pyrenomyc. Germ. 110 (1867); after Xylaria.
Thamnomyces, Ehrenberg in hor. phys. Berol. 79, t. 17 (1820); after Xylaria.
Nummularia, Tulasne select. fung. carpol. II, 42 (1865); after Hypoxylon.

Physalospora, Niessl Notiueber Pyrenomyc. 10 (1876); after Hypoxylon.
Daldinia, Notaris & Cesati schem. sfer. Ital. I, 197 (1870); after Hypoxylon.
Dothidella, Spegazzini fung. Argent. IV. n. 186 (1882); after Dothidea.
Gibellia, Saccardo & Berlese in Rev. mycolog. (1885); after Dothidea.
Chaetomium, Kunze mycol. Hefte I, 15 (1817); after Diatrypa.
Corynelia, Acharius in Fries observ. mycol. II, 343 (1818); after Sphaeria.
Rhizomorpha, Roth in Usteri Annal. I, t. 1 (1797); after Sphaeria
Scortechinia, Saccardo & Berlese in Rev. mycol. Apr. (1885); after Sphaeria.
Didymella, Saccardo in Michelia I. 377; after Sphaerella.
Didymosphaeria, Fuckelsymbol. mycol. 140 (1875); after Sphaerella.
Perithalia, J. Agardh in litteris. (1883); after Bellotia.
Dilophus, J. Agardh Algern. Systematik II, 106 (1883); after Dictyota.
Bactrophora, J. Agardh Algern. Systematik II, 22 (1884); after Mesogloia.
Glaphyrymenia, J Agardh Algern. Systematik IV, 52 (1885); after Hypnea.
Clothrix, Kuetzing in Regensb. bot. Zeit., 517 (1843); after Schizogonium.
Glocotila, Kuetzing in Linnaea XVII, 89 (1843); after Oedogonium.
Phyllactidium, Kuetzing in Linnaea XVII, 93 (1843); after Bulbschaete.
Sirogonium, Kuetzing in Linnaea XVII, 92 (1843); after Spirogyra.
Chthonoblastus, Kuetzing in Linnaea XVII, 86 (1843); after Oscillatoria.
Rhabdonema, Kuetzing Bacillar. 126 (1844); after Amphora.
Triceratium, Ehrenberg, Kreidethiere 79 (1840); after Actinocyclus.
Total number of Australian plant-genera, recorded hitherto. 2.249.

The indications of the places, at which these additional genera should be inserted into the systematic census, are not intended to convey always an enunciation of close affinity to preceeding or following genera, as often those, nearest allied, are quite wanting in the Australian vegetation, or have as yet not been discovered in this part of the world. The genera of evasculares have been respectively determined by illustrious specialists, namely by Gottsche, Stephani, J. Mueller, Knight, Cooke, Saccardo, J. Agardh, Kuetzing and Nordstedt. For the many additional genera of minutest fungs Mr. F. M. Bailey's collections, elaborated by Professor Saccardo, afforded largely the material on this occasion

Notes on the process of Polishing and Figuring 18-in. Glass Specula by hand, and experiments with Flat Surfaces.

By H. F. Madsen.

[*Read before the Royal Society of N.S.W., 7 July, 1886.*]

So much has been written upon the production of glass reflectors for use in astronomical observations, and so many of these being in use at the present time, any improvements in their construction would be difficult if not impossible to attempt; still, as the method which I have followed is not altogether the usual one, and as I am not aware that any mirrors of the size under discussion have been attempted by hand, I have thought it probable that certain notes taken down by me during my experiments might not be altogether void of interest to some of the members of this Society.

It is now more than four years ago since I first began polishing specula-flats, &c., with other optical experiments. During this period several mirrors from 7-in. to 18-in. diameter have been completed with gradually increasing success in the result. As the rough castings for the 18-in. mirrors were somewhat expensive, these have been refined and repolished several times to gain practical information in their construction. They were imported from Chance Bros., Birmingham, and when polished were found to have been well annealed.

A piece of plate-glass 10-in. diameter was cemented to the back of each mirror to suit its intended cell or mounting, and the weight of the whole speculum when finished was about 70 lb. (fig. 1.)

In producing these specula the first thing to consider is naturally the convex tool with which they are ground to the proper curvature; and my first attempt was made by procuring two flat discs of glass of the same size, and grinding them together with emery and sand, the intended speculum occupying the uppermost position until they had attained the desired form; it being well known that two flat discs when ground together will form themselves into spherical surfaces, the overhanging part of the top one producing convexity in the one underneath.

My succeeding trial was made by the usual iron tool turned to approximate curvature in a lathe; but it was found that two of these had to be ground together for a considerable time before

they became of a true spherical form; and knowing that the coefficient of expansion of iron was 0.000012, that of glass only 0.000008, and that in both cases the surfaces were very sensitive to small variations in temperature (as illustrated hereafter by my flat surfaces), I formed the opinion that a truer surface could be produced by having the tool made of the same material as the intended reflector, and therefore in producing the two larger specula under consideration I reverted to my former process.

Three plates of rough glass 1-in. thick and 18½-in. diameter were ground together to fit one another, and then cemented so as to form a firm and solid block.

To produce the proper convexity in so large a size in the usual manner would occupy a considerable time, and require a great amount of labour; yet such a form would be easily given to it by the machinery used by plate-glass grinders. I had the tool made of about one quarter more convexity than the required concavity of the speculum, and the latter having being partly hollowed out by the use of a leaden weight and rough emery, the two (tool and glass) having been ground together soon formed themselves into perfect spherical surfaces, and very nearly of the proper curvature.

Where many specula are to be produced upon the same tool, iron may be preferable on account of its surface becoming extremely hard; but I have with one of glass ground or rather refined the speculum during three hours, without producing so much as 1-in. alteration in the focal length.

During the course of my earlier attempts with smaller glasses, much time was lost in the polishing, the smoothing process not having been sufficiently carried out with the finest grade of emery, but with the two under consideration to-night, this was guarded against, and no polishing was begun until the mirror was bright enough to reflect the image of the sun at an almost perpendicular incidence.

In one instance, to ascertain the exact form of the surface given to the speculum by the glass tool, I endeavoured to render it thereby reflective enough without polishing for a preliminary examination at the centre of curvature. In this I did not quite succeed, but with 5m. polishing it reflected the light from a very small pinhole, and when thus examined I was delighted to find that it presented a true and regular surface, slightly inclining from the spherical towards the spheroidal form, and that irregularities of more than $\frac{1}{50000}$ part of an inch (probably much less) had no existence.

This proved beyond doubt that the class of tool I had used left nothing to be desired. The speculum having, then, at this stage of the process an absolutely true curve, the polishing was proceeded with in the usual manner with rouge upon pitch (the speculum being uppermost), so well described by the late Dr.

Draper, Mr. Wassell (English Mechanic), and others, until no emery holes or scratches could be seen by looking in an oblique direction at the reflected image of the sun near the focus.

In all cases, however, that I have seen described, the pitch polisher has been directed to be graduated into squares as in fig. 2, where it will be seen that the circles described from the centre will all intersect the squares at nearly the same angle. I have read that Lord Rosse, Dr. Draper, and others, had to add an extra motion (side motion) to the speculum to avoid concentric grooves or rings; but it seems to me that a polisher graduated as shown would naturally produce such, if the glass continually moved in the same track. I also found that when the pitch was very hard the glass would move more easily along the grooves than in any other direction; and therefore I graduated mine as shown (fig. 3), where it will be found that these defects are obliterated, and I may state that I have, without side motion, polished (by hand) for hours continually without producing as much as a trace of a ring.

The polishing for this size of speculum (by hand) usually occupies about seven or eight hours, but in the one before us to-night it was accomplished in five hours thirty minutes; after which it was tested and found to have retained its original shape, slightly inclined to the spheroid. (This, however, may have been changed often during the polishing.)

As shown hereafter in my method of figuring, or in converting the surface into a paraboloid of revolution, the spheroidal form would be as good to start from as spherical; but it must not be forgotten that the spherical form is the only state in which almost infinitesimal irregularities can be observed, except by varying the distance of the luminous point. In fact, so delicate is the Foucault test of a true spherical surface at the centre of curvature, that variations of 0·000001 inch (as is proved hereafter) can be noticed. Supposing, however, that a true spherical surface has been obtained, the most delicate part of the process commences, viz., to change it into a paraboloid of revolution, or what is the same, to correct the spherical aberration.

Some opticians have attained great success in this operation, and there can be no doubt that a similar effect can be produced more or less favourably in several ways. I will here enumerate some of them:—

1. By making the polisher a little larger than the speculum (Herschell), or by making it of an elliptical form, axis as 10 to 9 (Short's process). Without doubt this will lengthen the outside rays, but the regularity of the curve from the centre seems to me doubtful.
2. By gradually lengthening the strokes (Dr. Draper), not tried.

3. By raising the temperature of both glass and polisher, and before the pitch becomes of its usual hardness to use a few long strokes (half strokes), afterwards gradually decreasing them to nothing. This I have tried with partial success.

4. By local polishing, as adopted by Lassell ; perhaps the one now mostly used, and the process by which the greatest success has been obtained. Its defect is that small irregularities are almost impossible to avoid.

5. By graduating the pitch polisher, which in my experiments seems to be the process most certain of success ; yet in large surfaces, where a considerable amount of correction is to be performed, great care is necessary to avoid it running into an irregular curve.

As in this process the main point to be considered is the correct system of graduations to be used, I began by inquiring into the form of the solid interposed between the sphere and paraboloid of the same curvature at the point of contact, seeking thus to combine theory and practice.

The general equation to this solid becomes complicated, but as it was only required to know the variation in the thickness of a section from centre to edge by combining the equations of the circle and parabola, I deducted an approximate expression (correct for the usual shallow curves to eight places of decimals) thus :—

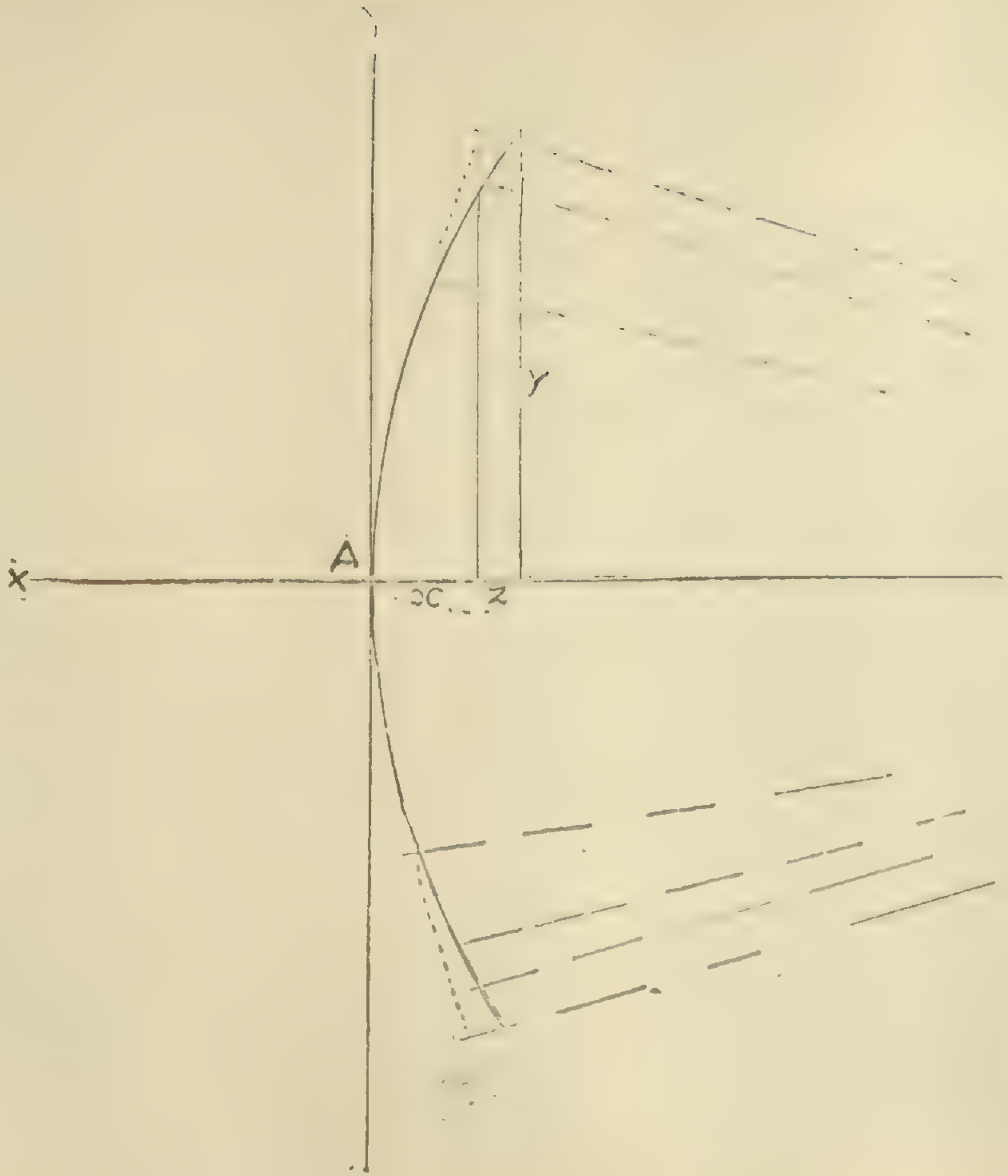
$$\text{Equation to parabola origin A is } x^1 = \frac{(y^1)^2}{4f} = \frac{(y^1)^2}{2r.}$$

$$\text{,, circle} \qquad x = r - \sqrt{r^2 - y^2}.$$

$$\text{which, being expressed in series, is } x = \frac{y^2}{2r} + \frac{y^4}{8r^3} + \frac{y^6}{16r^5} \cdots$$

Let now $y^1 = y$, and neglecting higher powers of y than the 4th, we have by subtraction $(x - x^1) = z$ equal to thickness for any value of $y = \frac{y^4}{8r^3}$ and supposing r constant, it is seen that such varies as 4th power of semi-diameter.

Let now z be calculated for intervals of 1 inch in the length of y with radius $(r) = 320$ inches as in the speculum under consideration, and as has been done in the subjoined table, the section will be represented by the following diagram (in which the solid line represents a section of the spherical surface, and the dotted line the corresponding parabola).



y in inches.	$\frac{y^4}{8r^3}$	$\frac{y^4}{8r^3}$ in millionth parts of an inch.	$\frac{y^2}{r}$ aberration at centre.	Approx. fractions.
1	0·000000025	$\frac{1}{250}$	0·003	$\frac{1}{320}$
2	0·00000016	$\frac{1}{16}$	0·0125	$\frac{1}{80}$
3	0·0000003	$\frac{1}{3}$	0·0281	$\frac{1}{36}$
4	0·000001	1	0·05	$\frac{1}{20}$
5	0·00000244	$2\frac{1}{2}$	0·078	$\frac{1}{13}$
6	0·00000496	5	0·1125	$\frac{1}{9}$
7	0·00000916	9	0·153	$\frac{10}{63}$
8	0·0000156	$15\frac{1}{2}$	0·2000	$\frac{1}{5}$
9	0·000025	25	0·2531	$\frac{1}{4}$

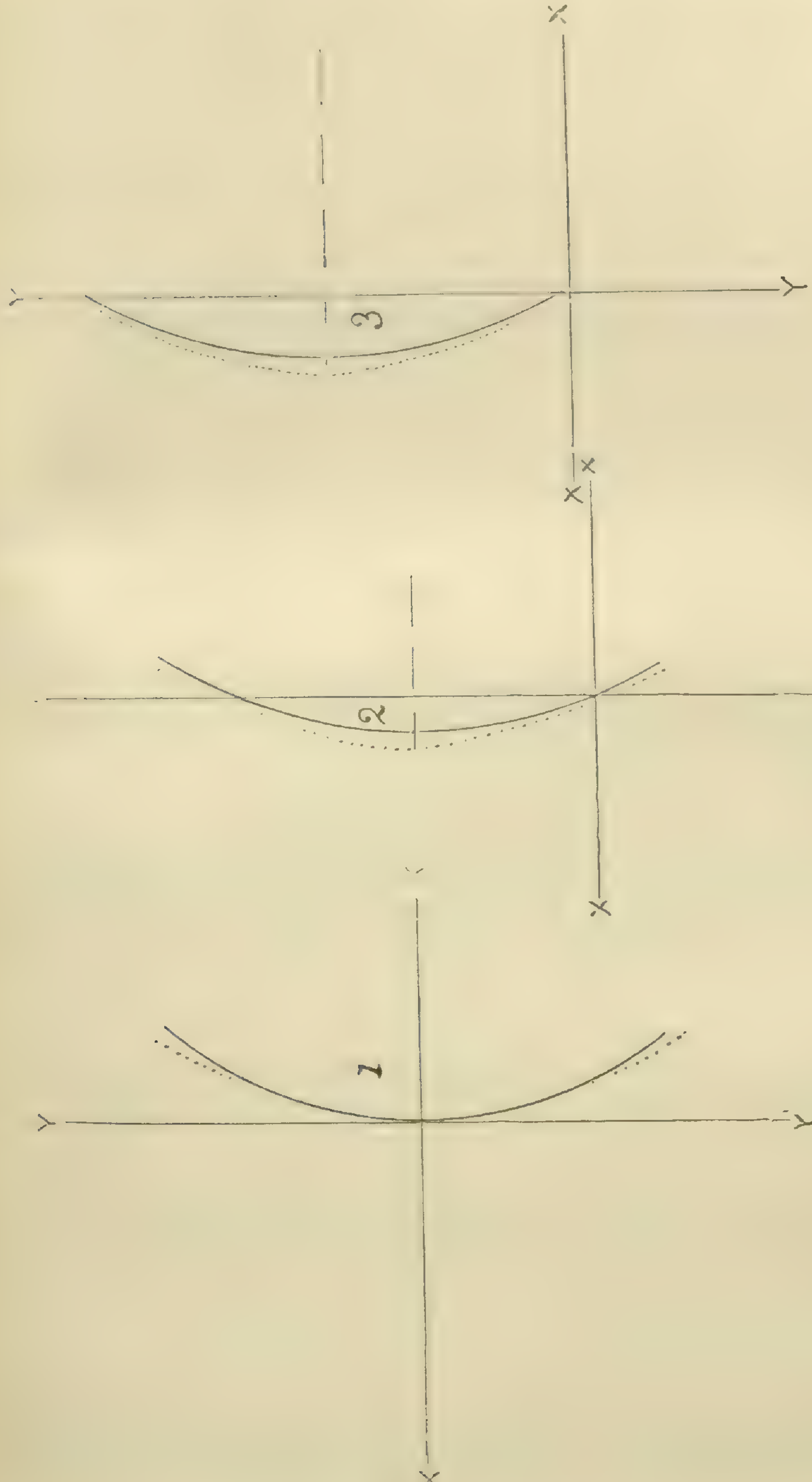
In this table the first column gives the length from centre of semi-diameter (y) in inches; the second and third, the corresponding magnitude of (x—x^1) or z, or the amount of abrasion required to change the section of a sphere into that of a paraboloid of revolution, and the 4th and 5th columns, the longitudinal aberration of the latter curve existing at the centre of its main or rather least curvature; calculated from the formula $\frac{y^2}{r}$ (approximately), and this is known to be four times the amount the same speculum would show (if spherical) in the telescope at its focus.

Although in this case the relative length of focus to diameter is not by any means an unusually long one, yet, by examining this table, some startling truths are revealed.

In the first place it seems wonderful that the deviation in a ray of light should become perceptible by the variation in the reflecting surface of one-millionth part of an inch, which is actually the case.

At 4 inches from the centre the distance from the two curves is only that amount, and yet this produces $\frac{1}{250}$ inch longitudinal aberration at the centre of curvature, which, under favourable circumstances, can easily be perceived; but, on the other hand, as this small variation might be produced by three strokes of the polisher, or by the smallest irregularity in temperature, it shows that practically the curve for the central 8 inches should be spherical, and that, with mirrors having very shallow curves as 12in. diameter to 20ft. focus, such a form is as good if not better than any other.

In the above calculations the point of contact (also origin of coördinates) of the two curves has been supposed to be at the extremity of their axes of revolution; but, as in the paraboloid the curvature increases continuously from centre to edge in the given ratio, other points might be selected either at the edge or at intermediate places, and the three cases would be as shown in 1, 2, and 3.


3
2
1

Figures 4, 5, and 6 (plate 1) represent the corresponding figuring forms of the polisher; by increasing or diminishing the acting part of these surfaces the time required can be altered. Of course the same object may be obtained by reducing the squares, as long as the given proportion is maintained.

Pitch being a yielding (non-elastic) substance, might be expected not to act similarly to a rigid surface, but still I have found Nos. 1 and 2 to give the desired result. No. 3 does not seem to answer with the weight of the glass over the polisher.

The form with which the present glass was figured was No. 2.

Both polisher and glass having been regularly raised in temperature were left together (the glass having been now and then slightly moved round its axis) until cool, after which the usual stroke for keeping the spherical form was proceeded with for about ten minutes, when the correction was found sufficient.

In another case, No. 1 form was used upon a similar mirror, but with only 10′ 4″ focus requiring abrasion at the edge exceeding $\frac{1}{20000}$ part of an inch.

Knowing that theoretically a curve of revolution could not coincide with the polisher, except when the axis of both were in one line, this position was maintained and the glass simply revolved. By this motion rings were expected to appear, but such was not the case, and in less than 10 minutes an over-corrected but true surface was the result.

The greatest inconvenience in this method is, that should the mirror become over corrected, or a hyperboloid, the polisher must be remodelled before the spherical form can be restored. A perfectly even temperature must exist, and the polishing powder be evenly distributed, with uniform contact at every point between the two surfaces before the correction or figuring can be satisfactorily proceeded with.

Supposing, then, that in this way a regular curve receding from the sphere through the ellipsoid towards the hyperboloid has been obtained, it will next be necessary to judge the exact time when the paraboloid has been developed, and to do this nothing is so satisfactory as the artificial star, or minute pinhole test at the centre of curvature, first invented by M. Foucault. For use in this test the fourth and fifth columns of the above table have been calculated, but it was shown that in mirrors in which the length of focus exceeded twenty times their diameter, no correction from the spherical form was required, and that the amount of such correction would increase in the ratio $\frac{1}{y^3}$ (y constant), from which it would seem that this form of specula would be the easiest to make perfect.

Such is, however, not the case except within certain limits.

The rate of decrease in the amount of correction required is very rapid with the increase of radius of curvature, but the injurious

effect from almost infinitesimal irregularities increases in a still higher degree, and it seems to me that even supposing that a theoretically perfect speculum could be obtained with from 20 to 40 feet focus, the slightest touch or variation in temperature would be sufficient to destroy its good definition under a high magnifying power, irrespective of the disturbing effect of the atmosphere.

By decreasing the focal length the rays cross at a less acute angle, and small variations in the reflecting surface have not so detrimental an effect.

The correction required increases, but that does not seem to be of much consequence, so long as the proportion is not less than 6 to 1 in glasses from 10 to 20 inches diameter, as it only requires longer work in the same direction.

Such are a few of my observations during my working of these specula, and considering their weight and the care necessary to avoid the slightest inequality in temperature by handling, &c., I almost think they are the largest size that can be produced by hand; but under the same process with suitable machinery I have no doubt that much larger surfaces can be satisfactorily produced under the condition that their focal length be not allowed to exceed 20 or at most 30 feet, which in the Newtonian construction (if required), may be lengthened by the introduction of a concave achromatic or Barlow lens.

In regard to silvering the mirror very little need be said, the process is now so well known (Brashear's method), that by ordinary attention to cleansing the mirror, equality in temperature and pureness of chemicals used success is inevitable. (See *English Mechanic*, 11th June, 1880 p. 327.) A nearly opaque film of silver can be obtained, which, by a few minutes polishing, becomes an almost perfect reflecting surface; but unless this can be proved to be extremely thin and perfectly even, serious injury may be occasioned to the efficacy of the reflector.

Some two or three years ago my attention was drawn to this subject by an unusually thick coating of silver applied to one of my mirrors. The definition seemed to be impaired, and the rays from bright stars to become more troublesome after silvering than before. This, it appears, was caused by the greater amount of light reflected from silver than glass: but, to prove that no change in figure had taken place, I determined to measure its thickness. The late Dr. Draper, in his work on the telescope, says: "The thickness of the silver film after polishing is about 1-200,000th part of an inch, and variations in that amount cannot therefore cause any optical defect in the telescope.*

* This has lately been doubted by one of the leading opticians in a letter to the *English Mechanic*; and in the last number of that paper it has been given by one writer as 1-200th of an inch, perhaps (?) a misprint, 4/6/86

His results were obtained by measuring the quantity of silver deposited over a large surplus, but my intention was to compare its thickness with the length of a wave of light. To do this I required two perfectly flat surfaces. After long and patient work, I succeeded in producing three such surfaces 5-inch diameter, which by the colour test, so admirably described by Mr. Brashear in a paper read before the Engineers' Society of Western Pennsylvania, produced at an angle of incidence of 65° one uniform colour gradually changing by other inclinations, and showed by monochromatic light straight, dark, and coloured bands (fig. 7.)

Several precautions must, however, be taken in using this test. An even temperature is absolutely necessary. The angle of observation should not be greater than 70° with the normal, but better much less, and the glasses must be as perfectly clean as possible.

These precautions refer more particularly to compound solar light. When monochromatic light is used, the test may not be so delicate, but is certainly of much more practical use, and as will be demonstrated correct to less than 1-200,000th part of an inch.

When one end of the glasses is pressed, or when impurities prevent them from being exactly the same distance apart, the deviation from theoretical flatness can be judged and rigidly calculated by measuring the curve or bends in the bands in comparison with the distance between them, which should be as large as possible **(say) from $\frac{1}{2}$ to $\frac{3}{4}$ inch.**

For, let A (fig. 8) represent two glasses 5-inch diameter placed together and illuminated by a homogeneous yellow light (wave length $= \lambda = {}_{4\,4}{}^{1}{}_{6}{}_{5}{}_{0}$) at an angle of incidence ϕ of 30°, then from optics it is known that the dark bands appear whenever the thickness of the film of air δ is $= \frac{n}{2} \lambda$ sec. ϕ and the bright ones at $\delta = \frac{2n\text{-}1}{4} \lambda$ sec. ϕ, and that consequently the deviation in thickness between two dark bands is expressed by $x = \frac{\lambda}{2}$ sec. ϕ, so, if thus a curve in the middle band were by measurement found to be $\frac{x}{2}$ the deviation from flatness in one or both of the glasses would be $\frac{\lambda}{4}$ sec. $\phi = 0.0000C65$; and, as even a much smaller displacement might be observed and measured, defects of less than ${}_{8\,0}{}^{1}{}_{0}{}_{0}{}_{0}$ in. can be seen. Having thus obtained my measuring scales, my silver film was estimated in a similar manner to the **above.**

An ordinary film of silver once repeated was deposited upon one of the glasses and a part of it afterwards removed by strong nitric acid. When the bands were next examined at an angle of

30° they were found to be broken or displaced at the edge of the silver, a distance about $\frac{2}{3}\,x$ (x = to distance between two succeeding bands).

The thickness of the silver δ would be thus expressed by $\frac{\lambda}{5}$ sec. 30, = 0·0000525 a quantity nearly agreeing with that given by Dr. Draper. Several similar measurements of single silvering or films gave results less than $\frac{1}{20000}$ inch.

The experiment was repeated with similar results, but on account of the excess of light reflected from the silver, part of which can only interfere with that reflected from the lower surface of the glass, the bands were difficult to be observed. The above expression might have to be added to any number of half wave lengths $\frac{\lambda}{2}$ sec. ϕ. but that such was not the case was proved by using compound solar light.

By repeated silvering, or by using a stronger solution, the film might be considerably augmented: yet it may be concluded that by ordinary care in the polishing no optical change will be produced in the reflecting surface.

To ascertain the exact effect produced by heat and pressure upon these glasses I placed them as before upon a wooden chuck, 2-inch diameter, and observed a uniform colour at 65°.

I then placed my finger, touching without pressure, upon the centre of the top glass and watched the effect. Almost instantaneously the colour changed to regular concentric rings continually diminishing in size but increasing in number by additional heat.

By lowering the point of sight these rings (fig. 10) travelled towards the centre, proving the glass to have become concave, and that by a measurable quantity. At first glance, this augmentation in the film of air immediately below the point to which heat was applied might be thought to have been caused by its excessive expansion in comparison with glass.

This is however not the case: the glasses were unconstrained, and if one part of the air between them expanded, it would only be the cause of lifting the glass equally throughout.

When the heat was removed to any other part above the top glass the same effect was produced, the lower surface becoming hollow at that point; but when the heat was placed in closer contact with the other surface, as at one end of a diameter, or at the edge, B (fig. 10), the very opposite was the result; both glasses expanding approached nearer and nearer to each other until no light was reflected.

From this it appears, that when heat is applied at the central part of one side of a round piece of glass the other side contracts and becomes hollow in a regular curve from edge to centre, and

that such an effect will continue for some length of time, it having been observed to do so in this experiment during 10 m. or more.*

It may also be noticed that when the source of heat was removed it only occupied 2 m. for the glass to return to its normal state, and that the thickness of the glass was $\frac{3}{8}$ of an inch.

The glasses were next removed from the wooden support to an iron one of the same shape, and although this had been kept in the same room, yet the chill from the iron was enough in less than 1 m. to produce convexity in the middle surfaces to the extent of $\frac{1}{3000}$ part of an inch, but also in a regular curve (fig. 11).

A pressure of 8 lbs. was next applied to the same central part of the glasses, when the colour began to change, but in a different manner to that produced by heat

Two wide bands of colour (fig. 12), appeared, reaching nearly to the edge of the glasses and crossed in the middle. showing that they had become strained in two directions, and their figure completely destroyed.

This shows that although pressure has to be avoided, yet the regularity in temperature is the most important factor in the production of the true glass surfaces, and that in finished specula (particularly with long foci) a very small inequality in the temperature of their sides will produce serious defects in their defining power.

It also shows that a material of small heat-conducting power would be the most desirable for the mirror to rest upon.

In conclusion, noting the regular contraction of the lower surface towards its centre, it has occurred to me that it might be possible to employ heat as an agent in the figuring of mirrors, but I have not yet tried the effect.

Since this paper was transmitted to the Society I have received the last monthly number of the "English Mechanic," in which I wish to draw attention to two articles. One, No. 25,603, by Mr. Brashear, in which the writer expresses the same opinion as I have, in regard to the practical superiority of employing a monochromatic source of light in the testing of flat surfaces; and another, No. 25,499, by Mr. Wassell (author of a long series of valuable papers on Glass Specula), in which my conclusion as to the thickness of the silver film seems to be doubted, and is sought to be disproved.

He says: "The fact that a thick film will receive a scratch that becomes visible by reflecting light from its sides, proves that the silver film is thick enough to perceptibly allow a deviation from the figure of the surface below."

---

* This result is what ought to take place. Heat applied at one side of the glass causes the molecules near the point of contact to expand; but it cannot pass through so bad a conductor, and consequently these in the lower side are pressed together, and the glass becomes hollow.

I do not maintain that variations even in the thickness of the film, as deducted by me, cannot by polishing be carried so far as to cause perceptible alteration in the figure of the speculum; in fact, that such can take place will at once be apparent by examination of the table for corrections as given in this paper; but, as to the visibility of the scratches proving anything in regard to the thickness of substance in which they appear, seems doubtful. Supposing the least particle which can be perceived by natural vision to be more than $\frac{1}{2000}$ part of an inch, it follows that whether the thicknes of the film be $\frac{1}{2000}$ or $\frac{1}{200000}$ part of an inch the depth of scratches could not be seen; nor do these appear to our view, as stated, by the light reflected from their sides, but simply by the width of the silver removed by them and the consequent exposure of the less reflecting surface below.

Discussion.

Mr. H. C. Russell, B.A., F.R.S., &c., stated that he was sure that all the members joined him in thanking Mr. Madsen for his paper, and for showing such a beautiful experiment; by means of which they could see the thickness of the air space between the glasses; for, by measuring the relative position of the dark lines produced by the film of air between the two plane glasses, it was quite possible to determine the actual thickness of the silver film. Mr. Russell then explained a spherometer for testing lenses, shown to him by Mr. (now Dr.) Schroeder, when he was in Germany some 12 years ago, and told how, by placing his finger on to the reflector, the heat of it bent it so much that the image was put entirely out of the field of view. Mr. Madsen's experiment was more beautiful, but not so easily applied as that of Dr. Schroeder.

Dr. Schroeder constructed a large refracting telescope for the Sydney Observatory, on which he bestowed great care, and it is supported in a solid brass cell: yet, if a slight pressure is made upon the side of the brass cell, the whole lens is bent. Great care is required in constructing large glasses, and some specialists refuse to make any larger than 8 inches in diameter.

However, he believed that one will shortly be made for the Lick Observatory, on Mount Hamilton, 36 inches in diameter.

[Three diagrams.]

Fig: 1.

'a' Speculum
'b' Iron Cell

Fig: 2.

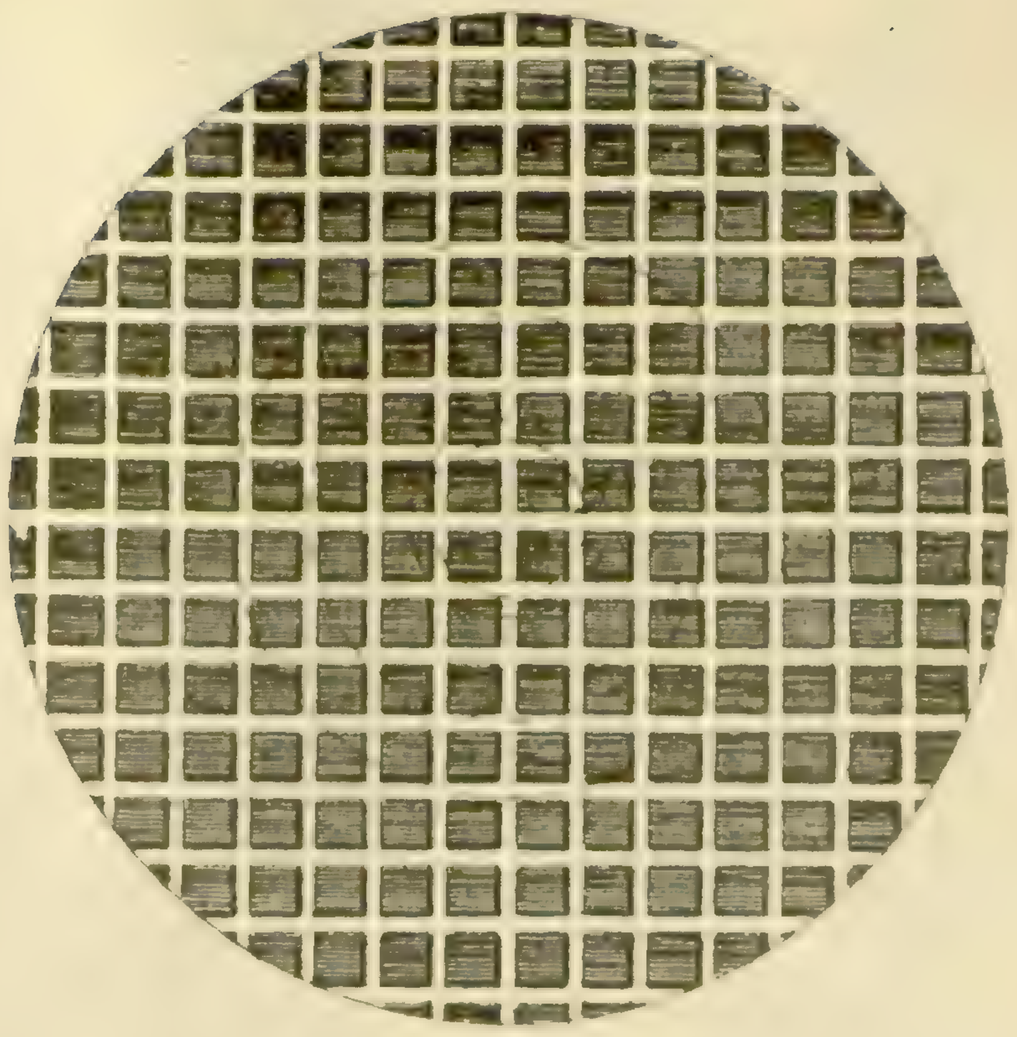


Fig: 3.

(Radius of Curves equal to Radius of Circle)

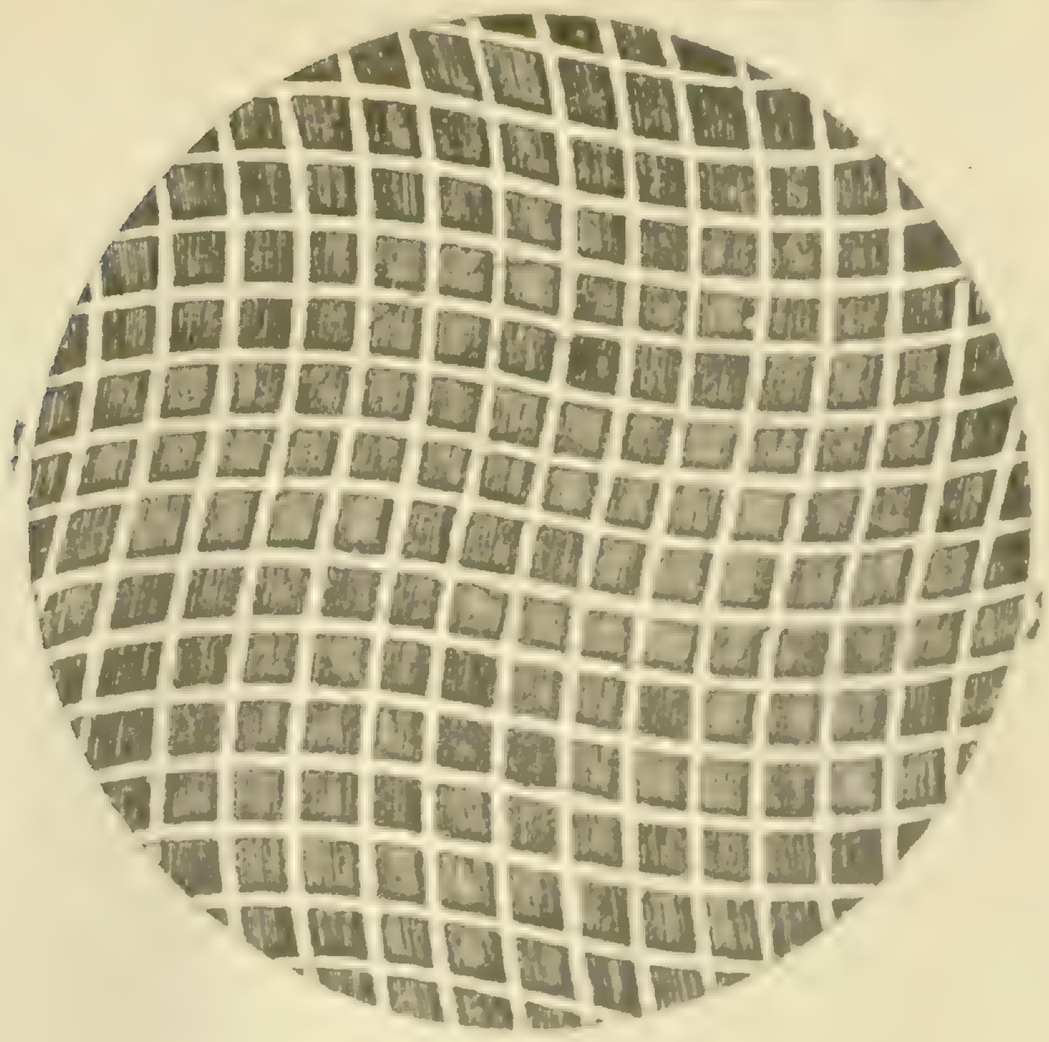


Fig: 4.

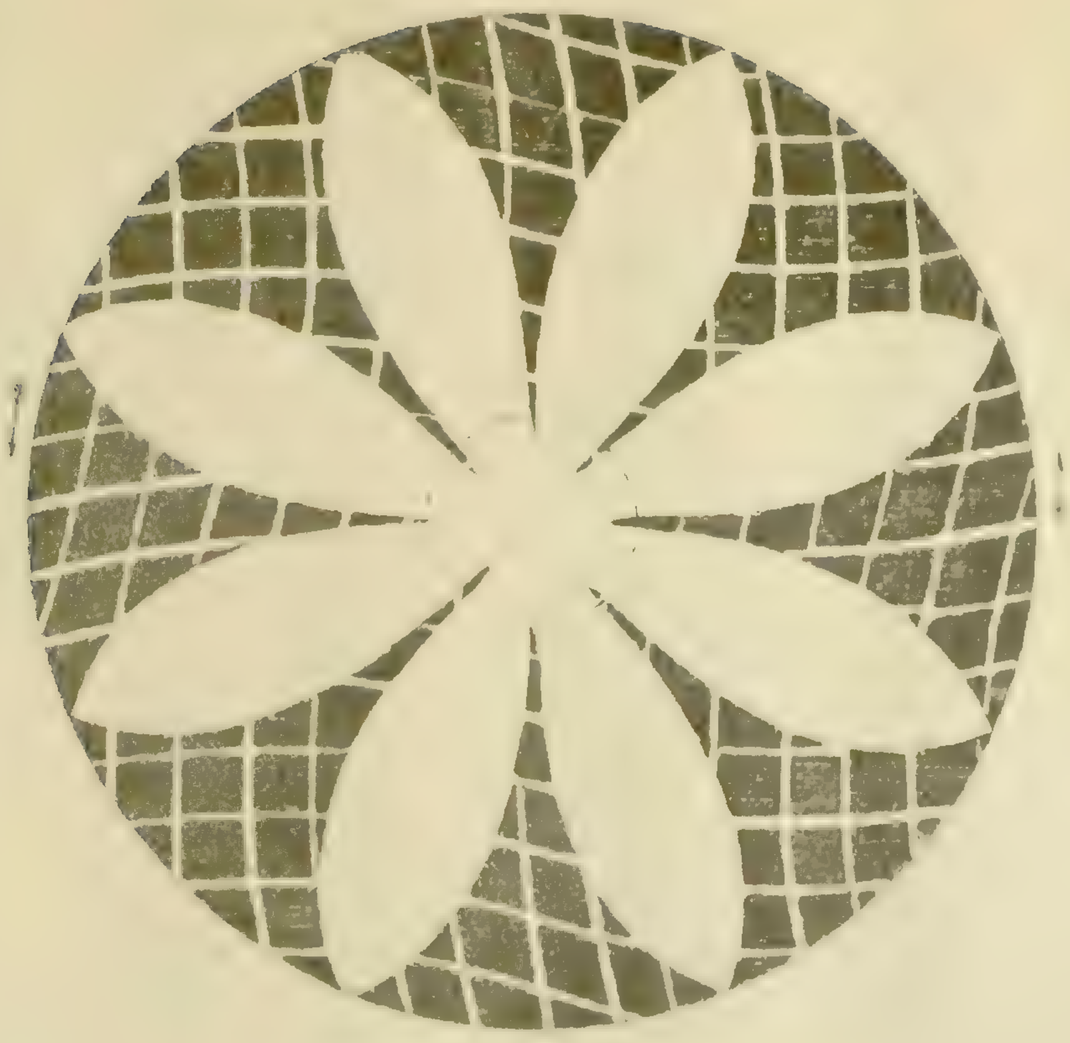


Fig: 5

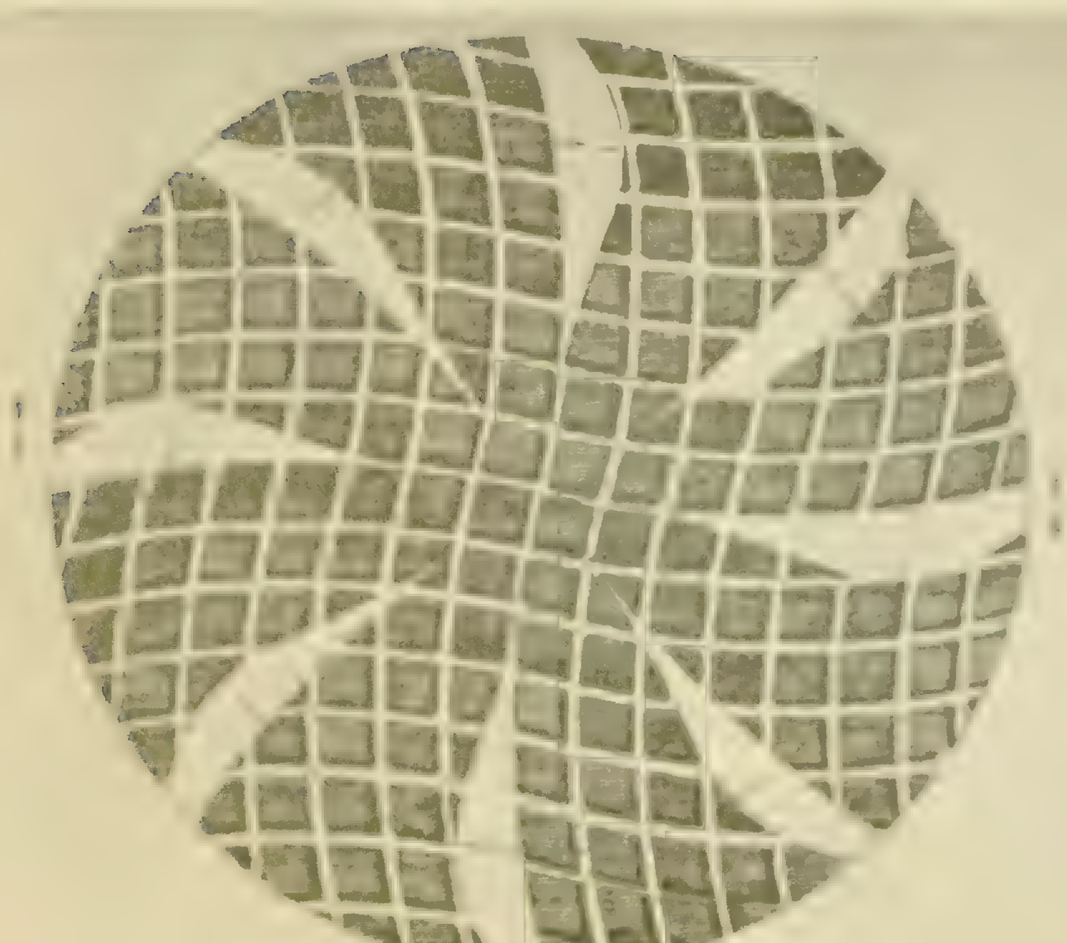
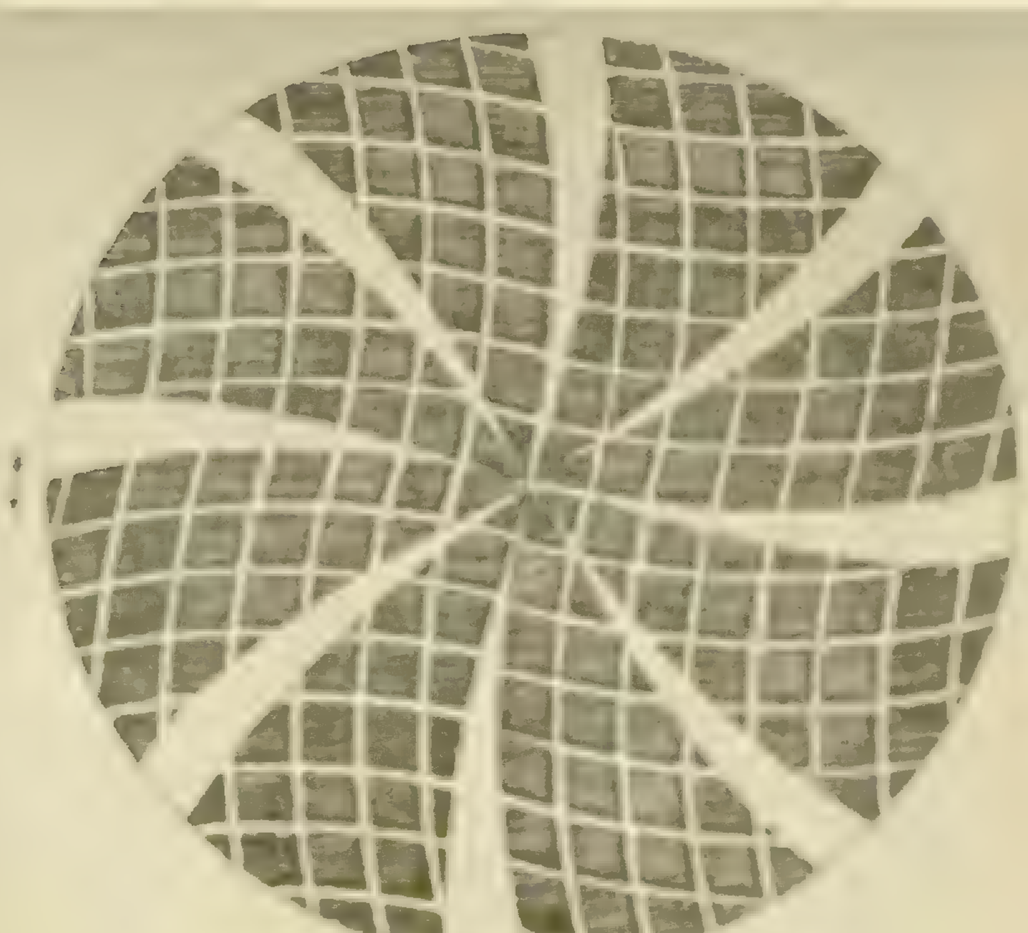


Fig: 6.



Scale - 2 Inches to One Foot

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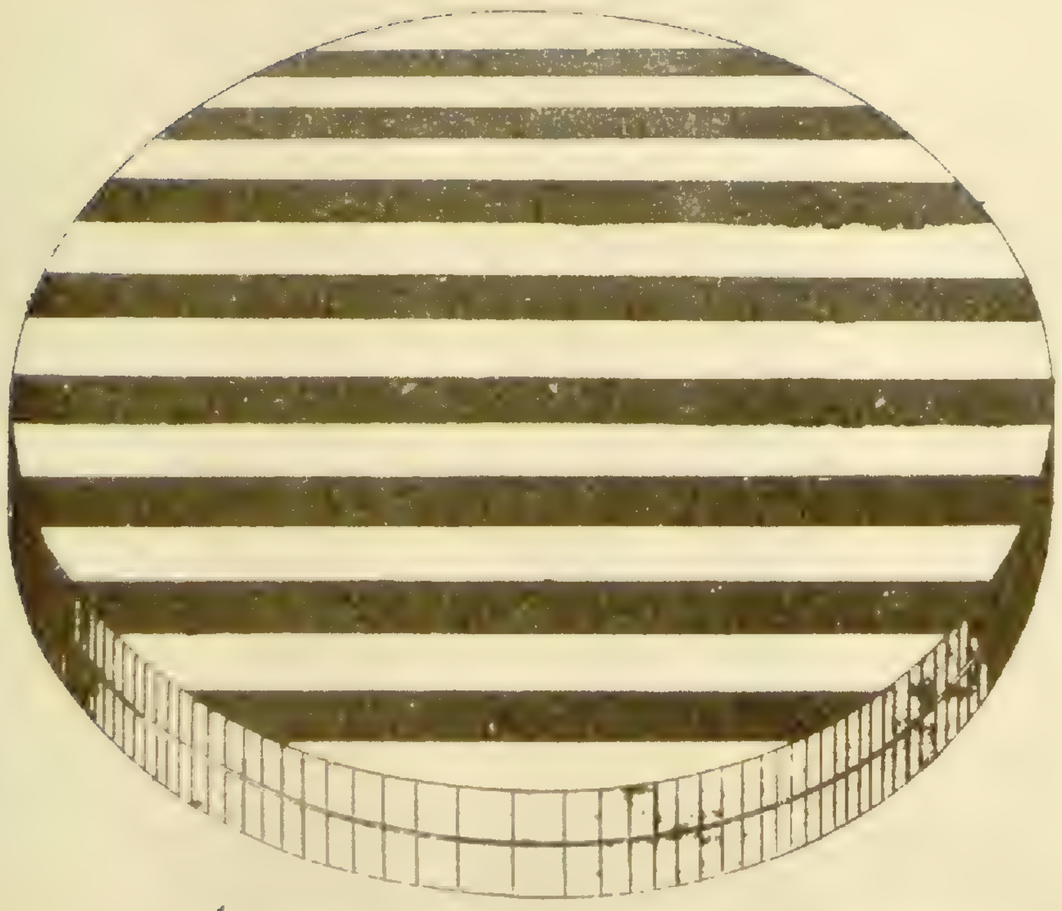
Fig: 7

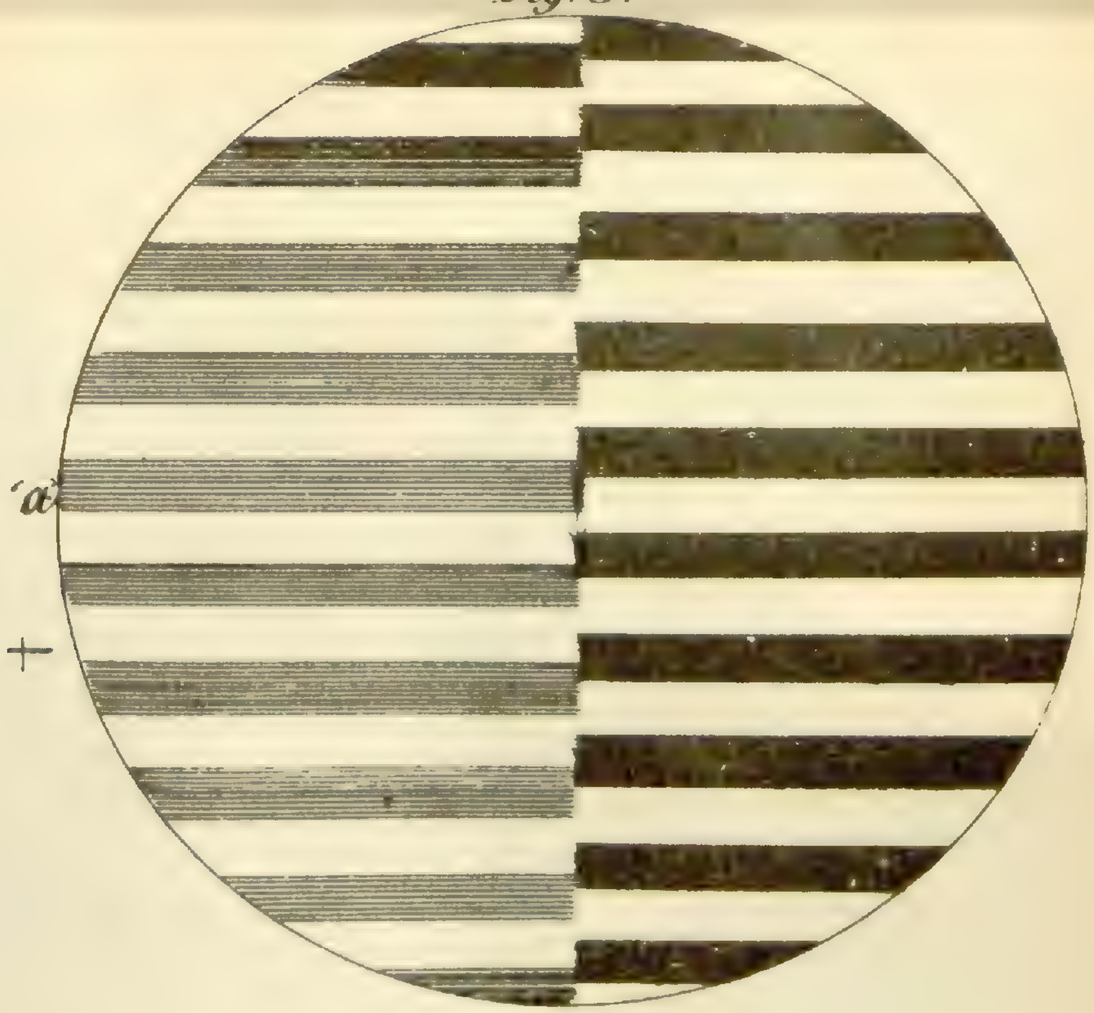


An equal film of Air or perfectly Flat Surfaces

Fig: 8

slightly convex
slightly concave

Fig: 9.



'a' Silver
'b' Glass

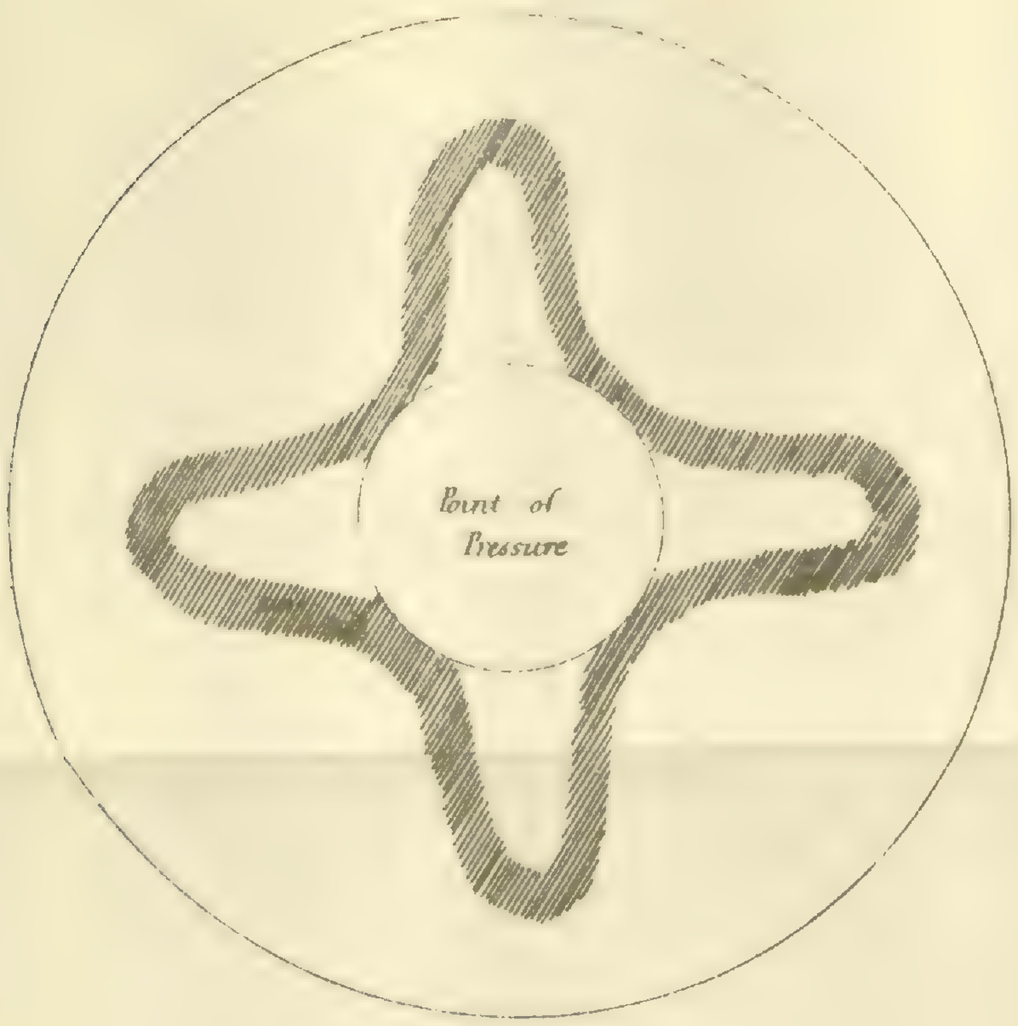
Fig: 10

Concave (By Heat)

Fig: 11

Convex (By Cold)

Fig 12



Pressure

(Figures 10, 11, 12 best shewn under Compound Solar Light)

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Tin Deposits of New South Wales.

By S. Herbert Cox, F.C.S., F.G.S

[*Read before the Royal Society of N.S.W., 4 August, 1886.*]

Introduction.

Although cassiterite or tinstone has been found on the Shoalhaven, Vincent Co.; Long Gully and Spring Creek, Argyle Co.; Burra Creek, Selwyn Co.; Dabarra, Bucclench Co.; Jingellic Creek, Goulburn Co.; Pullitop Creek, Mitchell Co.; and again at Tumberumba, near Kiandra, and at Attunga, near Albury (*vide* Minerals of New South Wales—Liversidge, p. 41), and has received some little attention in the latter localities, the principal deposits occur in the New England District, where they lie chiefly to the westward of a line passing from Armidale through Glen Innes and Tent Hill to Tenterfield, and thence to the Queensland Border.

Small deposits have been obtained to the eastward of this line, as at the Ding Dong mine near Deepwater, but they are mostly in isolated patches, the eastern country being chiefly characterised by auriferous veins and disseminations; while in the western area, as far west as Kangaroo Flat and Spring Creek, about 30 miles from Emmaville, the tin-bearing belt of country extends and runs from the Queensland Border as far south as Bendemeer, although the most important deposits yet found lie between Emmaville and Tingha.

Geology.

This area is replete with geologic interest, embracing, as it does, a great variety of igneous rocks both of hydrothermal trappean and volcanic origin, as well as Silurian slates, and those deposits of later date in which the alluvial tinstone occurs and which afford us some history of the physical geography of the country during periods which have preceded our own.

An official geological sketch-map of the district has been compiled by Mr. C. S. Wilkinson, from the researches of the late Rev. W. B. Clarke; but the first step in mapping the geology in detail has been undertaken by Mr. T. W. Edgeworth David, Geological Surveyor, who has published, in the Annual Report of the Mines Department, 1883, a map of the principal tin mining area near Emmaville, which will eventually form the basis upon which the geological structure of the country will be determined

I do not propose in the present essay to attempt any exact delimitation of the boundaries of the different systems of rocks, but there are several points of interest which have come under my notice, and which are, I trust, worthy of record although only illustrated by sketch sections.

The main systems of rocks which are represented in the district are as follow :—

(*a*) Igneous Rocks.

1. *Granite and Greisen*, partly metamorphic and partly as dykes and bosses.
2. *Acidic Igneous Rocks*, consisting chiefly of quartz porphyry and felspar porphyry (a coarse variety of porphyrite).
3. *Felspathic volcanic Ash Beds*, which are probably associated with the acidic eruptions last mentioned.
4. *Basaltic streams*, which overlie the felspathic ash beds in places.

(*b*) Sedimentary Rocks.

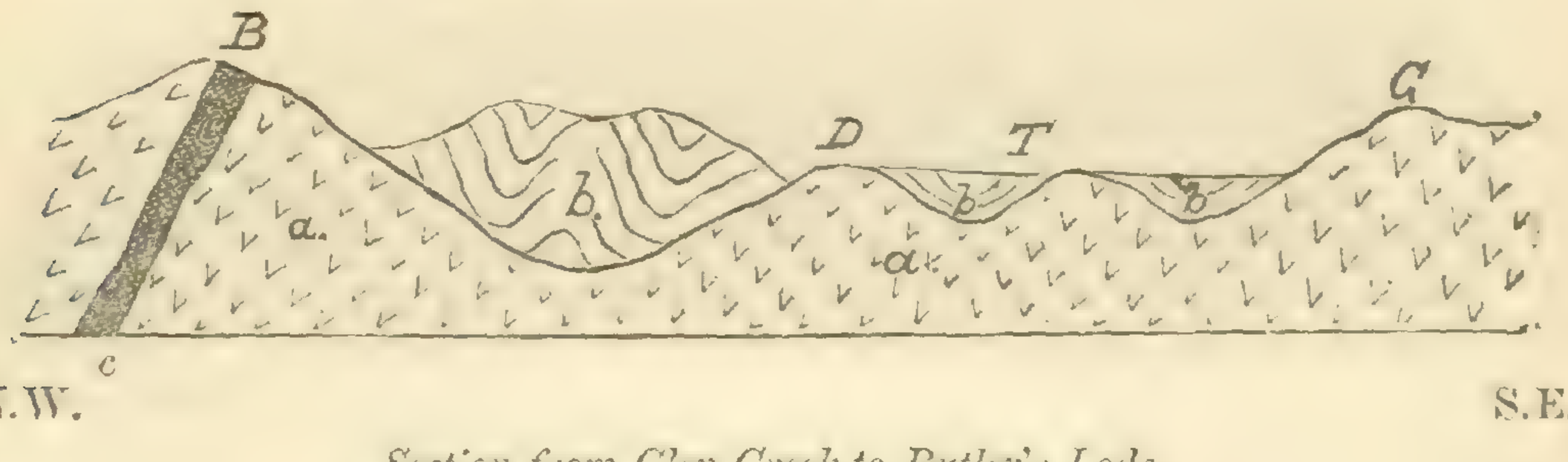
Probable Age.	Characters of the Rocks.
Silurian	Slates, sandstones, quartzites, and conglomerates, which are invariably standing at high angles and dipping away from the granites.
Miocene	Deep alluvial leads or river beds, which are in some cases older than the felspathic eruptions.
Newer Pliocene and Pleistocene.	Shallow workings and terraces with alluvial tin.

There is one point that will be suggested by a perusal of the foregoing table of formations, viz., that since the granitic eruption no sedimentary beds have been deposited in the New England area, with the exception of those alluvial deposits which have been laid down under subærial conditions; and, since it is pretty generally accepted that the granites are of from Devonian to Carboniferous age (See p. 86, Mines and Mineral Statistics), the tableland of New England must have been subjected to the ravages of atmospheric agents since the close of the Carboniferous period at least.

There is no evidence that, since the granitic upheaval first took place, there has been any cessation in the process of denudation, and in the period of time which has elapsed the quantity of material removed must be truly enormous.

This point is brought home to us whether we examine the flanking rocks of the Carboniferous series formed of the débris from these older beds which were tilted by the granite, or, on the other hand, study the New England District itself and find that the slates which yet remain are only outlying patches included in folds in the granites by which they have been partially protected from denudation.

A section from Glen Creek to Butler's Reef, in the Emmaville District, forms a good illustration of this—



Section from Glen Creek to Butler's Lode.

a. Granite. *b*. Slates. *c*. Lode.
B. Butler's Claim. *D*. Dolcoath. *T*. Taylor's.
G. Granite belt in which Hammer & Drill and Dutchman's claims are situated.

and it will be seen that, in places, the granite now stands high above the level of the slates, which, indeed, are only held as basins or synclinal troughs in the hollows in the granite.

This is in itself suggestive of the time at which the denudation of the tin-bearing rocks commenced, and may also assist us in tracing the period of the felspathic eruptions.

The dykes of felspar and quartz porphyry traverse both the granites and slates, and in Bailey's alluvial mine at Rose Valley, and, indeed, in other localities as well, tufaceous beds, which may be either true ash beds or may have been derived from the decomposition of the dyke rocks themselves, are found resting upon the tin-bearing gravels. These tufaceous beds correspond very closely, both in appearance and characters, with those tufas which are interstratified with the lignites of Mount Somers, New Zealand, and which flank the massive quartz porphyry (Liparite) eruption of that place.

What little evidence there is to be gathered would appear to point to the fact that the eruption of these quartz porphyries of New England only preceded the basaltic outburst by a short time, geologically speaking, and that these felspathic rocks are, in fact, the earliest acidic lavas of that period, which, while finding their way to the surface through rents in the earth's crust, were of two viscous a nature to flow to any distance from the centre of eruption, and in many cases began and ended their history as dykes through the country.

In some cases, however, these acidic outbursts were followed by fragmental eruptions of greater or less violence, and in some parts great quantities of felspathic ashes have accumulated on the surface.

The outpouring of these acidic lavas has been followed by basaltic eruptions, and the lines of fissure having been already determined, the more fluid basic lavas, when they were ejected, flowed for great distances down the valleys, often burying up the gravels of the old river-beds, and protecting the wealth of tin thus entombed from the denuding action of the rain.

These basaltic rocks are of very great extent, and have buried up enormous areas of country; thus, between Glen Innes and Inverell they cover an area over 20 miles in width, forming all the peaks of the Waterloo Range, and that area has not, up to the present time, proved to carry tinstone below the basalts, although alluvial workings exist about 7 miles east of Inverell. All the earlier features of the country were obliterated by these flows, and New England was reduced from a region of hills and valleys to one more nearly approaching a tableland in character, and, although some peaks remained above the molten sea, the ranges which now exist have been chiefly carved out of these basaltic rocks.

Occurrence of Lodes, &c.

Although up to the present time lodes appear to be somewhat rare in the New England District, there are certain undoubted instances of their occurrence, and I propose to describe in detail one of the more remarkable, premising that others will doubtless yet be found.

It is in the Emmaville District that the only true tin-bearing lodes are being worked. These are known as Butler's and the Dutchman lodes, but other outcrops, which appear on the surface to belong to the true fissure veins, are found in the Cumberton, Hammer and Drill, and Pearman Beacroft & Co.'s claims, all of which are situated near Glen Creek, and are on the line of the Dutchman's lode, which is being worked on the tableland.

The numerous other deposits of tin which are receiving attention, such as those in the Dolcoath mine and the so-called Ottery lode, belong to one or other of the irregular deposits which will be mentioned further on.

The Butler's lode may be taken as a fair type of these true fissure veins. It is well defined, varying in thickness from 3 or 4 feet up to 23 feet in some parts. It consists chiefly of quartz, many crystals of which are encased in chlorite, and in some parts of the mine this chlorite is very plentiful, carrying tinstone as crystals and crystalline patches.

The lode is a true one, lying between well-defined walls, and has an average north-east course, but where it pinches it generally takes on northing. In places the lode splits and while one portion goes to the northward, the other holds its north-east course, the

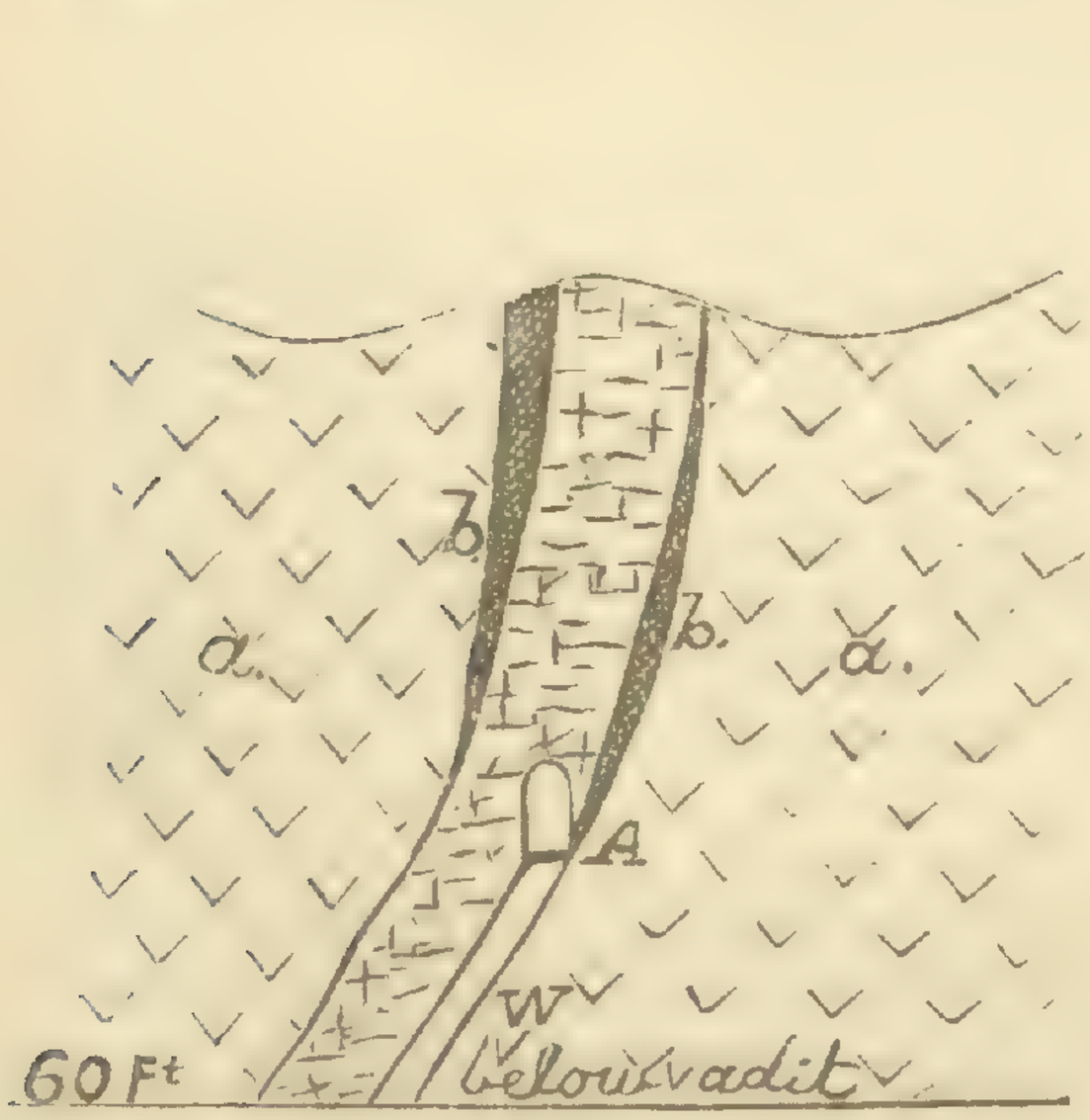
westerly branch as it leaves the lode underlying at a flatter angle than the more easterly one, so that the branches will probably junction again in depth.

The richer portions of the lode are generally on the hanging and footwall sides of the reef, where the tin occurs associated with quartz alone, but in many places the whole width of the lode is sufficiently rich to pay for working. So far as I can judge, about 5% of tinstone is a payable return, and in some cases even less is worked, 2 or 3 per cent. paying for crushing.

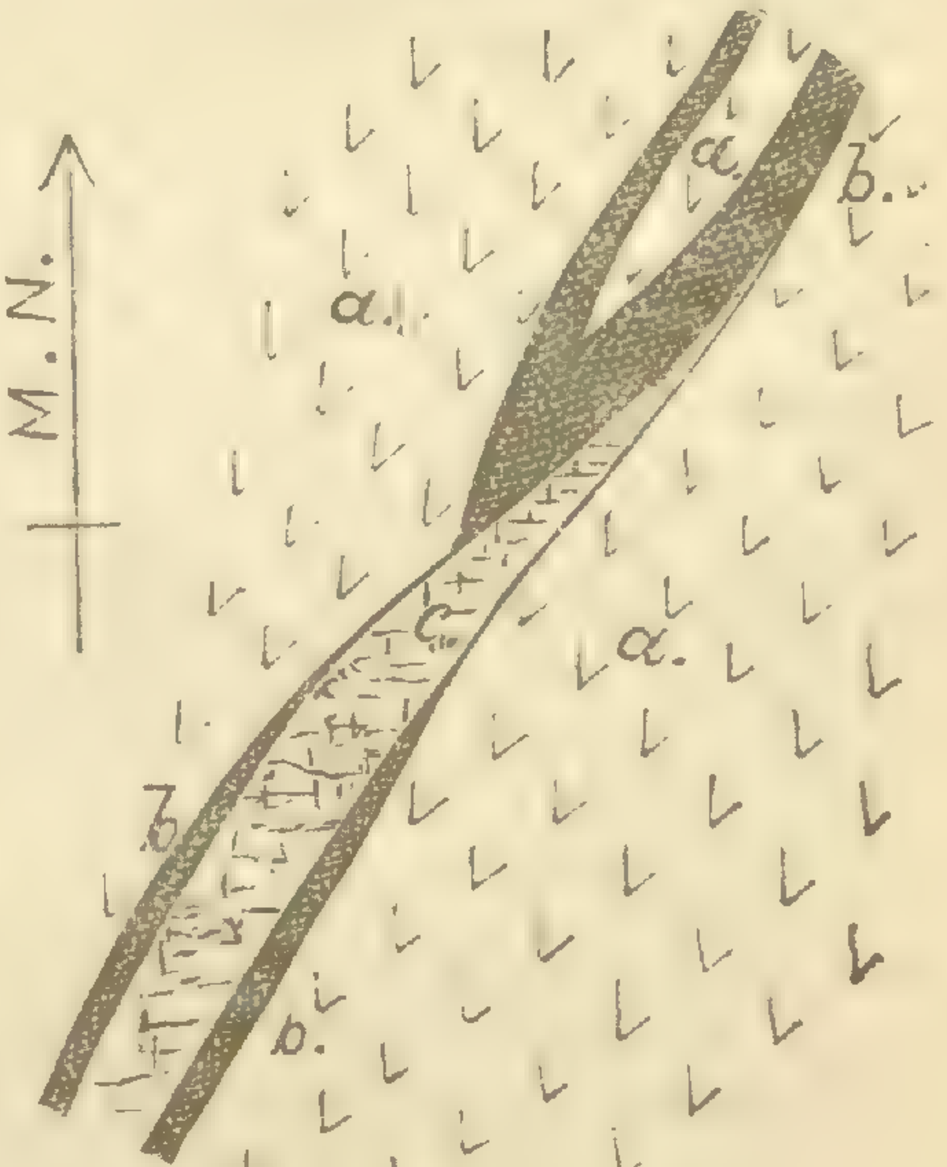
The lode has been traced for a great distance along the surface, and a shaft about 60 feet deep sunk from the adit level, carrying the lode down with it. The country in which the lode occurs consists of a porphyritic granite, which is decomposing rapidly on the surface, but there is not much white mica in the rock, and, although it is found in the lode, it does not appear to be of frequent occurrence.

The presence of chlorite in the lode is of interest as affording a parallel case to the gold-bearing reefs of Adelong, which also traverse granite, and it is probable that this chlorite is a product of decomposition of the rocks which were shattered by the movement which first opened the reefs.

The following sketches illustrate some of the points of interest in connection with Butler's lode. The positions of the rich parts are shown, as well as the pinching of the lode in depth, while the plan illustrates the occurrence of the ore along the course of the lode.



SECTION



PLAN

Section across Butler's Lode. *Plan of part of Butler's Lode*

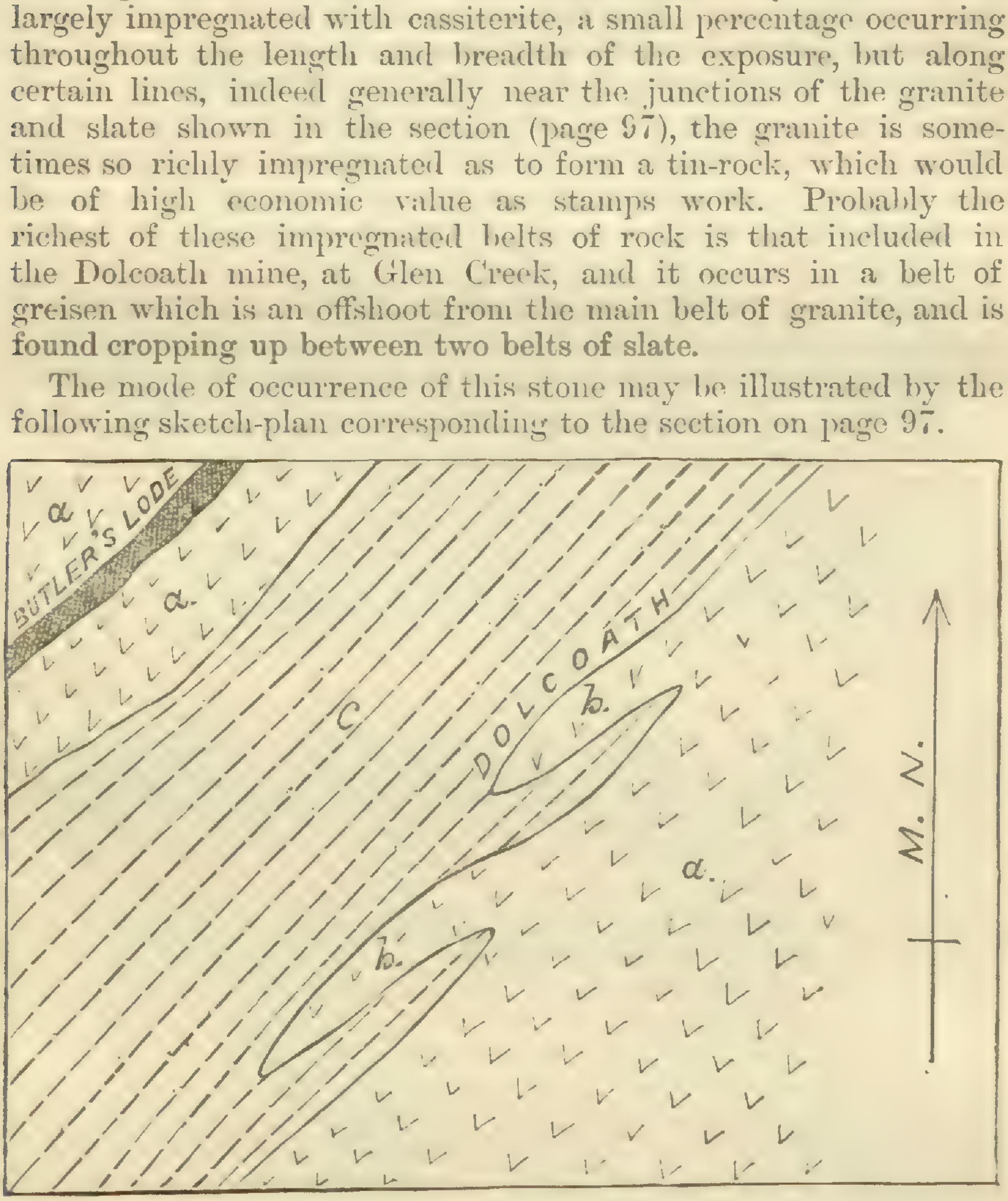
a. Granite. *b.* Rich tinstone and quartz. *c.* Chlorite lode.
A. Adit. *W.* Winze.

Irregular Deposits.

Although true fissure lodes do not appear to have been found very widely distributed throughout the New England area, there have been numerous deposits of tinstone discovered which are sufficiently productive to pay for working, and some of these are exceptionally rich. These are all somewhat closely related one to the other, and will be better described together.

The granite itself in the stanniferous belt already alluded to is largely impregnated with cassiterite, a small percentage occurring throughout the length and breadth of the exposure, but along certain lines, indeed generally near the junctions of the granite and slate shown in the section (page 97), the granite is sometimes so richly impregnated as to form a tin-rock, which would be of high economic value as stamps work. Probably the richest of these impregnated belts of rock is that included in the Dolcoath mine, at Glen Creek, and it occurs in a belt of greisen which is an offshoot from the main belt of granite, and is found cropping up between two belts of slate.

The mode of occurrence of this stone may be illustrated by the following sketch-plan corresponding to the section on page 97.



Plan of country between Dolcoath and Butler's lode.

a. Granite. b. Greisen. c. Slates.

It will be seen that offshoots from the main mass of granite are found cropping out at the surface between two belts of slate, and it is in these offshoots that the main impregnations of tin-

stone occur. The granite throughout this area carries a large proportion of white mica, but in these offshoots or arms the rock often passes into a true greisen so thickly impregnated with tinstone that a block less than 1 foot cube often weighs more than 1 cwt., and tinstone can be seen quite thickly speckled through the rock.

Throughout these impregnated areas numerous small veins occur in which the cassiterite has crystallized out, and in some cases these veins have well-defined walls for a short distance, in others the crystals of tinstone penetrate into the walls of the cavity ; but in either case they are doubtless veins of segregation, the tinstone in which has been directly derived from the surrounding country.

The deposits of the Gulf mines and the Giant's Den, near Bendemeer, are reported to be similar in character, and, judging from the general descriptions of them which I have been able to gather, there can be little doubt that such is the case since the tin seems to be very widely distributed, and, in the samples I have seen, appears generally to be disseminated through the rock. The same remarks will apply equally well to the new discoveries on the railway reserve 6 miles from Tenterfield.

In the neighbourhood of Tingha several attempts have been made from time to time to work some of these irregular deposits, and although at this time the Bischoff mine, at Stannifer, is the only one in which work is being carried on—and even this is understood to be on the eve of suspending operations—some description of the deposits will be of interest, more especially because some very rich patches of ore have been found from time to time.

The first claim worked was the Bolitho mine, where a leader only a few inches wide on the surface was traced for a considerable distance along a north-east course, and was also sunk and driven on. The stone was not particularly rich on the surface ; but at a short distance down it opened up, and some remarkably large and pure masses of cassiterite were extracted, one block over 7 cwt. in weight having been taken out solid.

There would appear to have been several patches of ore raised from this mine ; but work was eventually suspended owing to the stone running poor ; but even now there seems to be sufficient inducement to further prospect the claim, although, the shaft being full of water, it is impossible to examine the old workings.

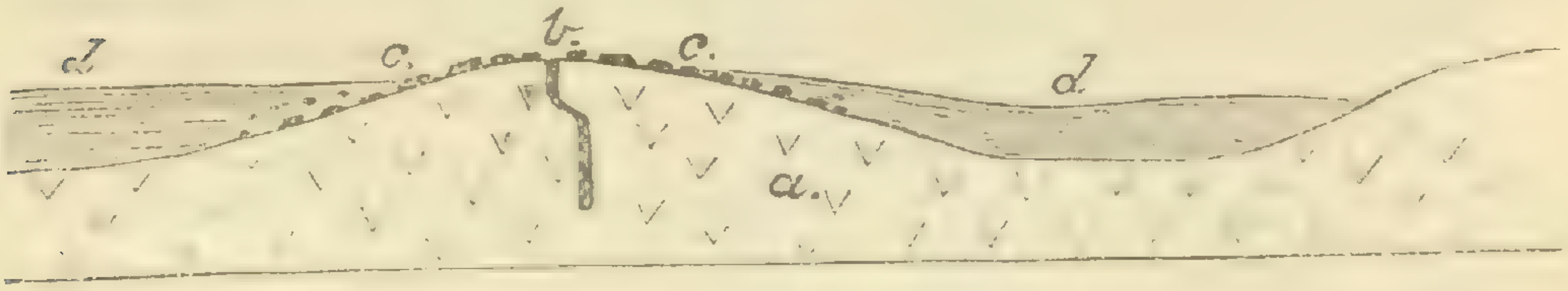
The country rock, which is granite, is traversed by a perfect network of veins of quartz carrying tinstone in greater or less quantity, and with economical crushing appliances would make a fair stockwork.

The tin deposits of Tingha belong chiefly to these "stockworks," for the Buchart mine, which lies about 2 miles north of the township, is another illustration of this class of deposit. In this

mine the main leader, which has been followed, and which is only a few inches in thickness, has also a north-east course; but the rock, which is a hard haplite, somewhat resembling a coarse elvan in character, is traversed by innumerable small strings and veins of quartz and tinstone which intersect the country in every direction, and form a perfect network of veins.

The Buchart Company has long since become defunct; but even now Chinamen are working the vein, and presumably making it pay, although they are only "fossicking" and crushing the specimens with a pestle and mortar.

Lying to the westward of this claim Partridge's mine is situated, and in this another vein of similar character has been met with, also coursing north-east, but the rock in which it occurs is a soft decomposed granite, and although there are several thin veins there does not appear to be so complete a network as in the other localities mentioned. The deposit is, however, of considerable interest, and the following section will illustrate the mode of occurrence of the ore.



Section across Partridge's claim.

a. Granite. *b.* Vein, carrying tinstone. *c.* Alluvial tin. *d.* Soil.

The alluvial tin has been found on either side of the granite spur, but at no great distance from the ridge, and close to the vein, the granite was literally paved with tinstone. It would appear probable that this rich alluvial deposit had been derived from floors which were tributary to the vein, as the stone in the vein itself has not hitherto proved to be rich.

Gash Veins in Slate.

Closely associated with those deposits last described are some which, while not appearing to be of much economic value, are still of great scientific interest. These deposits occur as thin veins or leaders traversing the slates which occupy the hollows in the granites already alluded to, and which are shown on the section (page 5). Some work has been expended on these veins, both in Taylor's claim, Glen Creek, and also on parts of the area held by the Dolcoath mine.

These leaders are seldom more than an inch in width, and consist chiefly of quartz with large well-defined crystals of tinstone; but in one case, in Taylor's claim, a vein of this sort has widened

to about 4 inches, and a quantity of white mica occurs in the leader which is consequently greisen, and so might be looked upon as a segregation vein.

These veins would appear to have been formed by fractures of the rock during the upheaval of the granite, by the folding of the slates in fact, and as no subsequent movement appears to have taken place it is extremely improbable that these veins will lead down to true lodes below, but will most likely finish at the junction of the granite and slate in depth. The granite, however, would probably be impregnated with tin at the junction, or even contact deposits might occur.

A good deal of work has been expended on these veins, and I venture to think more attention has, perhaps, been devoted to them than they deserve; but gash veins are of such rare occurrence that these deposits are deserving of mention, although even these are very poor illustrations of a class of deposits to which some authors attach so much importance, but the existence of which has previously been called in question both by Mr. J. A. Phillips and myself.

Near Silverton tinstone has been found as large crystals through greisen which is traversing schist, the granite cropping out, near by, both to the east and west. At Pearson's claim, Poolamacca, a large body of stone is reported to occur about 8 feet wide between well-defined walls, but the rock would lead one to believe that it had been intruded from below. The characters of both the vein-stuff and the country would augur well for the future of the district from a tin-producing point of view.*

Associated Minerals.

Other minerals have been found in great variety associated with the deposits of tinstone in New England, although they are not, hitherto, quite so diverse in character as those described from the tin-bearing areas elsewhere, but this is probably due to the fact that the country has not yet been so carefully studied, mineralogically, as the older and more settled mining districts of Cornwall and Germany.

Most of those minerals, however, which are generally looked upon as the inseparable associates of tinstone elsewhere have been found in New England; and first of all should be mentioned wolfram, which is the curse of the tin-miner in Cornwall, where it frequently occurs in the same lodes as the tin, and, in consequence of its specific gravity, which is identical with that of tinstone, defies all attempts at separation by purely mechanical means. This wolfram has been found somewhat plentifully in New England, but, fortunately, so far it generally occurs in different veins

* See Mr. Wilkinson's Report on the silver-bearing lodes of the Barrier Ranges, p. 10, 1884.

from those which carry the tin* and so, in view of the new applications which it has lately received in steel manufacture, may be looked upon as a new source of prospective wealth, instead of only an encumbrance.

Copper pyrites is a common associate of tin, especially around Dolcoath, where some very rich samples occur, but generally only as small patches in the rock. In some veins arsenical iron pyrites occur in considerable quantities, notably in the centres of the lodes, but it is also impregnated through the rock in greater or less quantities.

Veins of fluorspar have been found, but they are not of frequent occurrence, and the deposits hitherto have been small.

Other minerals containing fluorine in their composition, such as tourmaline and white mica, are of frequent occurrence; and topaz is exceedingly common in the alluvial deposits, sometimes as fairly perfect crystals, one in the possession of Mr. D. Porter, at Tamworth being of great size.

The association of beryl with the tinstone of the Gulf mine is well known, but its occurrence deserves a passing mention here, since it is unusual to find beryl literally forming a rock, as in this locality, with tinstone impregnated through it.

In the Inverell District, diamonds, sapphires, zircons, &c., are found associated with tinstone in alluvia, or perhaps it would be more correct to say that tinstone occurs in the diamantiferous deposits, for there is not sufficient tinstone present to pay for the extraction of that mineral alone, although it can be saved in the process of diamond-washing, and serves to partially defray the expenses of working.

The tinstone itself occurs in a variety of forms and of different colours. Even in the same mine we frequently find pure white oxide of tin, ruby tin, resin tin, and deep black crystals. In some cases I have seen one-half of a crystal white and the other half red; while in others, again, the different colours blend, one with the other, in a most remarkable manner. The tinstone also varies greatly in its degree of coarseness, large crystals an inch through being associated with the finest dust, and this, in addition to the amount of slimes necessarily made in crushing a brittle mineral like tinstone with a battery, renders perfect saving appliances absolutely necessary.

At Pearson's claim, Silverton, previously referred to, some of the tinstone has a most remarkable iridescence—green, red, and blue—imparting to it the appearance of a copper mineral, but this is probably due to some physical character of the tinstone. although it is possible that impurities in the ore may account for it.

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* At Hogue's Creek lodes Mr. Wilkinson reports its occurrence with tin and Bismith. (*Vide* Annual Report, Department of Mines, p. 155, 1883.)

Alluvial Deposits.

The alluvial deposits may be divided at once under two heads—

a. Deep leads
b. Surfacing and shallow placers

and these require separate treatment in a description. The greater quantity of tin which has hitherto been raised in New England has been derived from one or other of these classes of deposit, and it was the shallow leads, those in which the cover seldom exceeded 40 or 50 feet, which first brought this Colony into prominence as a tin-producing district.

All the alluvial deposits of any importance hitherto discovered are confined to the area previously defined, and appear to have been derived directly from the parent rock on which they rest, and so may serve as a guide by which impregnations and lodes may be traced.

In the Vegetable Creek area the shallow leads have now been all worked out so far as European enterprise is concerned, but the Chinese, who are now in equal numbers with Europeans, about 500 of each being registered, still continue to rework some of the old claims.

Some exceedingly rich deposits were found at the Y Waterhole and Graveyard leads, and again close to the township of Emmaville and at Rose Valley, some of them resting on the main bottom, others, as mentioned by Mr. David, upon basalt, below which deep leads have been struck; but although the shallow leads are found higher up the valleys the courses of the deep leads generally correspond very closly with those of the shallow ones, which have been deposited during more recent times.

At Tingha numerous shallow deposits have been worked out, but at the present time little is being done except by Chinamen who are working on Cope's Creek, but although there are even now over a thousand at work large numbers have left the locality lately.

It has been stated that these shallow leads are now, to all intents and purposes, exhausted, but the history of the deep leads is yet in its infancy.

These deposits are found below a varying thickness of cover, from 140 feet to about 180 feet; and in some cases the leads are buried below solid flows of basalt, while in others no basalt is met with in sinking. The basaltic streams, however, appear, up to the present, to have formed the main guide in the search for deep leads, and, stretching from Emmaville, an almost continuous stream of this rock has been traced through Kangaroo Flat to Spring Creek, a distance of about 30 miles.

This area has been prospected at various points, but it is in few places only that payable tin has yet been found, of which Rose Valley, Two Mile, Kangaroo Flat, and Spring Creek may be

cited as the only places which have yet been shown to carry tin in leads which are worth working.

There would seem to be some reason to believe then that these different deposits have not been formed by one and the same stream, or, if they were, have received their tin from lateral streams which drained into the valley of that time; and this is more likely to be the case when we consider that between the Two Mile and Kangaroo Flat a distance of 15 miles intervenes, which has hitherto proved unproductive, and a barren area of equal length exists between Kangaroo Flat and Spring Creek; but, at the same time, it must be borne in mind that the main channel may have been missed in the various prospecting shafts that have been sunk, and so that leads may yet be discovered.

In support of this view it may be mentioned that at Rose Valley a great deal of work was expended by Bailey and party before any payable leads were found, that worked by the Wesley Company having taken a different course to what was originally supposed; but sufficient inducement was found to continue prospecting, with the result that at the present time a lead, from a few yards to 30 yards wide, and from 2 feet to 8 feet thick, has been found in Bailey's claim, and has been driven on for 400 yards without any sign of change in the deposit. What is supposed to be a continuation of this lead is found in the adjoining claims, Fox's and Cuneen's, and will probably yet be found in Moran's and Gordon's claims, although, I understand, over £6,000 has been expended in prospecting the latter without anything payable being struck as yet.

This lead in Bailey's claim was found by driving from the old workings along a tributary gutter, and when struck a shaft was sunk to work it and also to drain the ground and a large quantity of water was met with in the early days of the mine, which has now been reduced to a minimum, and is easily kept down by baling.

The section of the shaft, as given me by one of the proprietors, is as follows:—

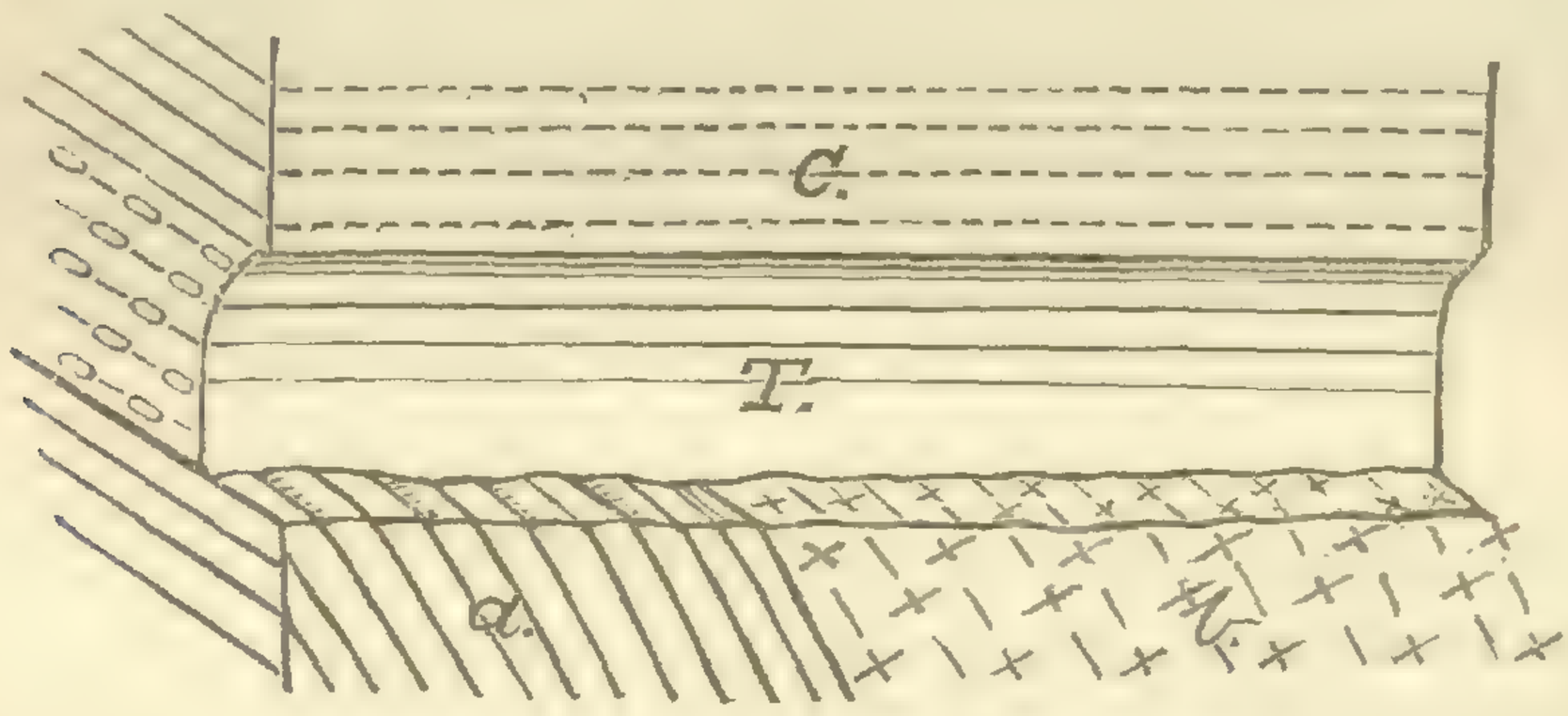
Surface.

Soil and pipeclay	80 feet.
Pipeclay	10 ,,
Drift (no tin)	6 ,,
Sediment	12 ,,
Drift (no tin)	8 ,,
Sediment	9 ,,
Tin-wash	8 ,,
	133 feet.

From which it will be seen that the basalt is not passed through in sinking, although in the same claim, and at a short distance only from the shaft, the solid basalt is met with, and is as much as 80 feet thick.

I was not able to examine the section of this shaft as it is lined, but some of the material on the surface, which is included in the first 90 feet of sinking, appears to consist of a fine-grained felspathic ash, which has been converted, at places, by decomposition into clay, and these ash beds are found in other sections underlying the basalts.

The bottom in Bailey's mine is of great interest. It consists of felspar porphyry in part, resting upon slates, each of these constituting the bottom in different parts of the mine. The following section will illustrate their relations, and is taken along the course of the tunnel :—



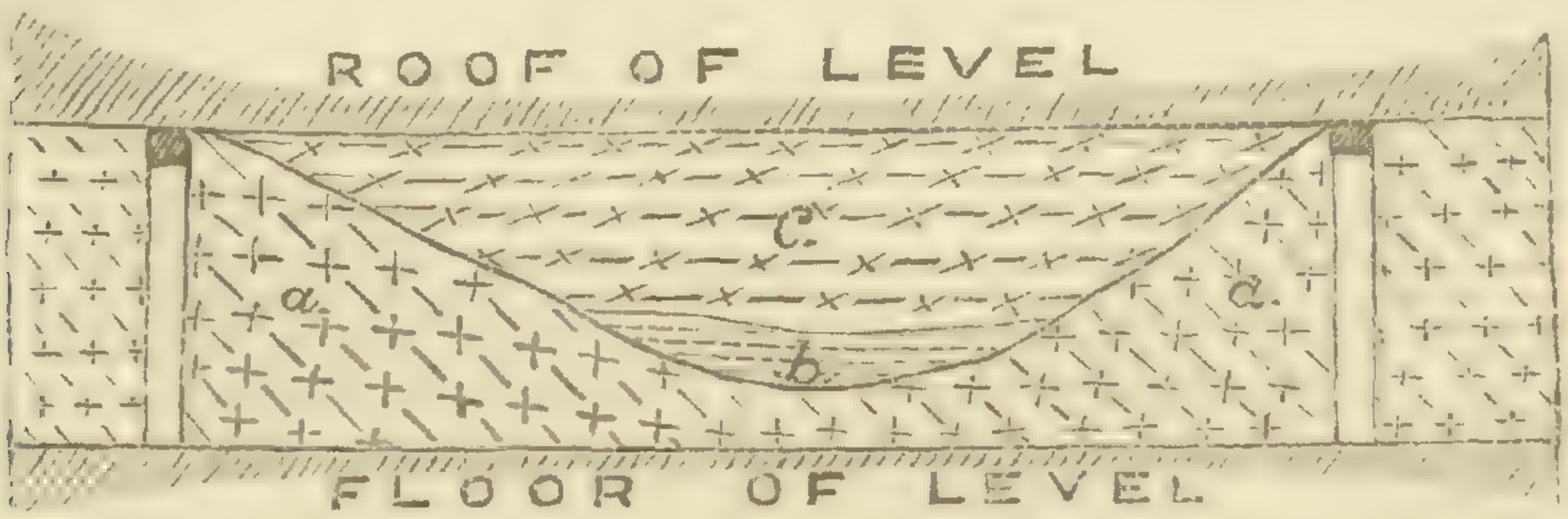
Section along tunnel in Bailey's Claim.

T. Tunnel from which wash-dirt has been removed :—

a. Slates. b. Felspar porphyry. c. Sediment overlying the tin-wash.

and I believe a similar section was met with in the old workings.

This felspar porphyry, which is called granite locally, is looked upon as the main bottom in the district, and, as a general rule, such is undoubtedly the case. It is of the greatest importance, however, to place on record the fact that at one point in this mine there is an undoubted instance of a tin gutter on this rock, the lead of tin being overlain by a rock which corresponds in all respects with the lower one. This section is cut across by a small prospecting drive, in the side of which it can be seen, as follows :—



Section along prospecting drive in Bailey's Mine.

a. Felspar porphyry. b. Tin-wash. c. Felspar porphyry (tufa ?).

Although this lead of tin is small and has no immediate economic value, its occurrence is of great importance as furnishing evidence of the possible widespread occurrence of leads below some of these acidic volcanic rocks, more especially when it is considered that there are very widespread areas of these rocks, below some at least of which tin leads may yet be found.

I have devoted a good deal of space to a description of Bailey's mine in this essay, not because it is the only alluvial mine in the district, but on account of its value and the many interesting features which can be elucidated there.

Deep leads are also being worked in the Tingha District, as in the Brickwood mine, and again at Stony Creek; but up to the present time, although they lie below the basalt and are subject to all the disadvantages of deep sinking, they do not appear to be sufficiently thick to pay. At the Brickwood claim the wash is not more than 18 inches thick on an average, and $\frac{3}{4}$ cwt. to the load is not, I am informed, payable.

Relations of Igneous Covering Rocks.

It will be apparent that a great deal of interest attaches to the period of the different eruptions of the igneous rocks of the district, apart from the economic aspect of the question, which is intimately associated with the period at which the deposits of alluvial tin commenced to be formed.

With regard to the formation of the tin-leads, it will be well to glance back for a moment to the conclusions which we have arrived at regarding the characters of the tin-bearing deposits in the slates and granites, and in doing so we find that the greater number of those yet known occur as impregnations through the granites or as veins of segregation, and in both cases the tin was probably introduced into the rock contemporaneously with the formation (metamorphism) of the rock itself. Whether it originally existed as a fluoride of tin, and has since been converted into oxide, the numerous fluorides which are associated with the tin deposits having been formed at its expense, or not, is a matter of very little importance from our present point of view, for, in any case, we may look upon the tin as contemporaneous with the granite, although the true lodes were filled during later times, and the formation of the alluvial deposits would commence so soon as the tin-bearing rocks were laid bare and exposed to surface denudation. This could only have been brought about during, geologically speaking, recent times, since all granite having been formed at great depths below the surface of the ground, an enormous amount of material would have to be removed before the basal wreck now exposed could have been brought to light.

It is probable that during the early history of this district some dykes of quartz porphyry and felspar porphyry might have been intruded through both the granites and slates, the haplite at the Buchart mine being a possible illustration of this; but there are no means yet available for distinguishing these, if they do occur, from those later eruptions which preceded the basaltic outbursts of Miocene or Pliocene times.

The evidence adduced from Bailey's mine shows us that tin-leads were in course of formation during the acidic eruptions, and that, in some cases at least, tin-leads may be overlain by felspar porphyries, but the nature of the rock itself will preclude the idea: —

(1.) That any widespread surface flows of these rocks could occur, because they are necessarily of too viscous a nature to flow far from their vent, and therefore

(2.) That tin leads could not be buried up by them unless the rocks had been inverted during a series of eruptions, as with the domites shown by Professor Judd in his work on volcanoes.

But although this is the case we must not lose sight of the fact, already alluded to, that in some cases the fragmental eruptions, attendant upon these outbursts, form rocks which are very difficult to distinguish as hand specimens from those which have really been extruded in a molten state, and these fragmental rocks may, and indeed no doubt will, form the covering of deep tin-leads.

What constitutes Payable Tin.

a. In lodes.
b. In alluvial.

It is a somewhat difficult thing to state with authority what proportion of tin will pay for extraction in a country like this, where the facilities for working vary so greatly in different localities, and I shall content myself with giving a few illustrations of what is considered payable.

First, as regards lodes, and in this category I would include those irregular deposits to which I have alluded, but which have to be crushed in the same manner as true lodes.

At Butler's lode, which is situated about 16 miles from Emmaville, over a very rough track, 5 per cent. of black tin is considered payable, a battery, driven by steam, being erected on the ground, and but little lost in treatment.

At Dolcoath, which is fully 6 miles nearer Emmaville, but in the same direction, 3 per cent. stone will probably pay to crush, especially when it is considered that the quantity of stamps work in sight is very considerable, and doubtless even less would pay for crushing at Tent Hill, which is close to the smelting works.

We may conclude, however, that where deposits of any size exist, even in places which are not easily accessible, a yield of 5 per cent. of black tin would be a payable return.

As regards the alluvial deposits, reference need only be made to the deep leads, and in these from 1 cwt. to ½ cwt. per load of 27 cubic feet is considered payable, the valuable lead in Bailey's mine, which has already been fully described, being payable at ½ cwt. to the load, with 133 feet of sinking. In shallow ground of course much smaller returns will pay.

Methods of Treatment.

As regards the methods of treatment employed considerable improvements have been made of late years. The original shallow leads were worked very imperfectly by sluicing, and that much of the tin was lost is shown by the fact that the old "burrows" are often reworked by Chinamen; but the sluicing appliances now used are far more perfect, and, with the introduction of under-currents, very little tin would be lost.

An apparatus known as a "Willoughby" is also employed for cleaning the tin at some parts, and acts on the principle of Collom's jiggers, but instead of the water being delivered from below in intermittent pulsations there is a steady flow from below through a perforated plate, and it is claimed that the tin can be thoroughly cleaned by this process.

Where crushing is resorted to in the lodes, &c., buddles and slime-tables are principally used, and the final operations of tossing and packing are employed, as in Cornwall. At Butler's lode four convex buddles and a self-acting slime-table are employed, and very little tin appears to be lost, as next to nothing could be obtained from the tailings with a vanning shovel.

At the Tent Hill works, which probably possess the most perfect plant in the Colony, the crushed ore is first passed through Rettinger's separators, and from there is taken to two pairs of Petherick's separators, which are in principle the same as Collom's jiggers, and from the last pair of these the finer material goes to a side-blow percussion frame. A rotating slime-table is also employed, and the tailings are finally run over convex buddles.

As regards smelting works, a very complete plant exists at Tent Hill, under the able management of Mr. J. Reid, charcoal being employed as the fuel: and although the price of black tin a short time ago reached £59 per ton at Vegetable Creek, presumably on account of a Queensland buyer there offering higher prices for the ore, it has since fallen again to the former price, viz., £54 per ton, and at Tingha, from which place the whole of the tin is sent to Sydney, the price has remained steady at £53 per ton.

In conclusion, I would mention that, notwithstanding the enormous output of tin, no less than 64,794 tons 6½ cwt. ingots and 15,268 tons 11 cwt. tin as ore having been exported from the tin-fields from the time of their opening in 1872 to the close of 1883, there is yet room, in my opinion, for a great extension of this productive industry, in the development of both deep leads and lodes, as well as those irregular deposits which approach the lodes in character.

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The Aboriginal Names of Rivers in Australia Philologically Examined.

By the late Rev. Peter MacPherson, M.A.

[*Read before the Royal Society of N.S.W., 4 August, 1886.*]

It is the purpose of this paper to pass in review the names which the aborigines of Australia have given to the rivers, streams, and waters generally of the country which they have occupied. More specifically, attention will be directed to the principles if discoverable on which the names have been given. In this inquiry constant regard will be had to the question whether the Aborigines have followed the same general principles which are found to prevail in other languages of the world. Without further preface, it may be stated that all available vocabularies will be searched for the terms used to designate water, whether in the shape of rivers, brooks, or creeks; expansions of water, as oceans, seas, bays, or harbours; lakes, lagoons, pools, or waterholes; swamps, or marshes; springs, or wells; rain, or waterfalls; and any other form in which water is the important element.

M, imitative of the sound of Waters.

Words for Water containing the letter M.

To make a beginning, let one of the imitative root words for water be chosen as the basis of experiment. There is the letter *M*, which represents the *humming* sound pertaining to water, whether flowing in streams or moved by tides and winds in ocean expanses. In carrying out the experiment the method followed will be (1) to examine the vocabularies for root-words designating water in any of the shapes already indicated, and embodying in the present case the letter *m*; (2) to examine the gazetteers of the several colonies, to ascertain how the same letter is embodied in the actual names of rivers, streams, and waters generally; and (3) to compare the results with the root words for water in other parts of the world.

Proceeding tentatively then with the letter *m*, is it to be found embodied in root words meaning water within the four corners of Australia? To this question there is the answer that the simple form *amu*, meaning *water*, is found in the region of the Ballonne. At Rockingham Bay the form *hammoo* is found also meaning *water*. Here, there can be no doubt, the same root is concerned, although the *m* is doubled and the word is increased by the addi-

tion of an aspirate at the beginning. In Victoria such forms as *ummut* and *ammitch* for *sea* are found. Here then are tolerably plain evidences that the letter *m*, as a matter of fact, was used by the aborigines as in some way specially fitted to occupy a place in words intended to represent *water*.

Turning now to the gazetteers and books of Australian travel for the actual names of rivers and streams, there are found such names as *Ma-Ma* and *Mi-Mi* Creek in Queensland. In New South Wales there is *Ooma* Creek, a form which so closely resembles the word *amu*, *water*, which has already come before us. Still further, in Victoria, there is the *Moe* swamp. In such cases, where there is no other consonant than the radical *m* itself, the conclusion seems every way reasonable that *Ma-Ma* and *Mi-Mi* and *Ooma* and *Moe* just signified the *water* in the lips of the people who lived on the banks of these waters respectively. In farther consulting the gazetteers, large numbers of compound words for rivers and waters are found to contain the termination *ma*. Thus there are such names as the Murr*uma* Creek, Mutt*uma* Creek, and many more. Here, however, an apparent difficulty occurs, for as the aboriginal names are scrutinized the form *Mia-Mia* is found to designate a mountain. In the meantime it may suffice to point out that *m* is found to be a radical form used to designate water, but not mountains; and (2) such a name as *Mia-Mia* pretty plainly points to the aboriginal term used in some parts of Australia, meaning a shelter of boughs and branches broken off the trees. The *Mia-Mia* mountain, accordingly, was very probably so named from some circumstance regarding aboriginal shelters upon it.

The next stage in our inquiry is to compare the result so far attained with what has taken place among tribes and nations in other parts of the world. In pursuing this part of our subject, it is to be noticed that the form *mo*, for water, remounts to a very high antiquity, as it was employed by the Egyptians. Closely allied was the Phœnician form, *mu*; in Hebrew *maim* is the plural for *waters*. At this point it is not amiss to point out that the letter *m*, especially in its running still more than in its capital form, has a pictorial significance in addition to its fitness to represent water owing to its humming sound, for the letter *m* is taken from the hieroglyphic representation of the ripple on the surface of water, and has found its way into a large number of the alphabets of the world. But, still pursuing the subject, it is to be noticed that the form *ma* is the Arabic for *water*; *uma* is the Draverian; and the same root-letter is found in the Tungusian and other Asiatic dialects. Still farther, *mam* means *fresh water* in the island of Tarawa, while *mem* means the same in Rotumah; *amai* and *huamo* denote the swell of the sea in Maori; *mi* is *water* in the Tigre language; and the root occurs in many more African dia-

lects. *Mem* is *water* in the Upper Sacramento in North America. Whatever may be the ultimate meaning or value of the foregoing facts, one point is clear, that the aborigines of Australia, in adopting largely the imitative *m* to denote water, have gone on the same principle as many other tribes of the human family in other parts of the world.

Root-words for Water represented by MB.

Having started with the letter *m*, we must be guided by the phonetic laws to which letters are subject; or, indeed, as we are proceeding tentatively, our inquiry may be regarded as keeping an eye to the question, whether or not language amongst the aborigines of Australia was subject to the same leading general laws which are found to prevail elsewhere.

But as to the affinity between the two letters *m* and *b*. We are familiar with such illustrations as these:—*Brotos* means a *mortal* in Greek. With the primative *a* there would be *abrotos*, an *immortal*. But *b* in any such predicament displays its affinity for *m*, hence the actual form is *ambrotos*. So, reciprocally, the affinity of *m* for *b*: from the Greek *gameo*, I marry, there would be some such form as *gameros*, one related by marriage, a son-in-law, but the actual form is *gambros*. Dealing with the names of rivers, we have the *Sabis*, the name of a stream in Gaul mentioned by Cæsar; but at the present day the *Sabis* of Cæsar is the *Sambre*. In this case both an *m* and an *r* have been added to the earlier form. Again, there is the *Abers* of Ptolemy: that river is now understood to be the *Humber*, in the north of England. Here not only has the *b* shown its affinity for the *m*, which has been introduced to keep it company, but another tendency of language is also illustrated: it is the lengthening and strengthening of the initial syllable—the feeble vowel is fortified by the introduction of the aspirate. Now, the aspirate is closely akin to the gutturals *g* and *k*, and, as we shall see, the aboriginal names of streams present a large number of illustrations in *cmb*, *gmb*, *kmb*, with their phonetic equivalents.

But proceeding with our task, and working up step by step to the longer forms, we have to look at the materials which illustrate the combination of the letters *mb* in root-words for water. In the vocabularies we notice *yambaai*, a lagoon, and *alumbah*, a spring, ka*lumbo*, salt water, in Western Australia. In the gazetteers we find *Amby* River and *Einbo* Creek, *Vamby* Creek *Wambo* Ponds, *Combo* Creek We*comba* Lake, Mo*varnba* River, Wallo*mbi* Brook, Yari*mba* Creek. Also, it is this combination of *mb* which supplies some of the most stately forms for names of streams, as War*amba* and Warra*gamba* Rivers. Also, such a name as *Tumby* Island, in South Australia, illustrates the fact that root-words for water are used to denote islands and promontories.

Looking now beyond the boundaries of Australia, we find illustrations to our present purpose in the Malay and Feejee languages. There is in Malay *ombak* a *wave*, *kumbuh* to *wash*, *Tambak* a *fishpond*, *tumba* to *draw water*. In Sumatra there is a river named *Jambi*, exhibiting the combination of letters *mb*. Moreover, this river gives name to a district, which drains the waters of several other streams besides the *Jambi* itself. In the Feejee vocabularies occur the words *dhomba* to *throw water*, *mbiau* a *wave*, *tomba* a *bay of the sea*. The foregoing forms, both Malay and Feejee, are in *mb* ; but the Malay supplies some in *mp*, thus : *ampah* and *limpah*, to *overflow*. But in dealing with *mb* there must not be omitted the form *ambu*, *water*, in the Sanscrit. The Latin *nimbus*, a *rain-cloud*, is also an example to the point. It may be noted that while the stately forms in *mb* are so conspicuous in Australian, Malay, and Feejee, they seem to be very deficient in Maori.

Amplifications of MB in MBL, MBN, MBR.

The addition of the liquid letters *l n r* to the combination *mb* produces some of those euphonious names which have often been admired ; thus there are Bar*ambil* Creek, Bour*imbla* Creek, Curr*ambene* Creek, Wi*ambone* Creek, Pi*ambong* Creek, Pi*ambra* Creek, and *Wambera*l Lake.

In looking to other languages root-words can be found in *mbl* and *mbn* referring to water, thus in Malay *ombal* means *wet*, *tembul* is to *rise to the surface*, gal*ambung* is *foam*, ki*jambang* is a *water plant*, pa*mambang* a *ferryman*, *tambang* to be *conveyed by water*, *lembang* to *drain*. Including this last word is the name Pa*lembang*, which is applied to designate a district in Sumatra, which drains the waters of a number of rivers besides those of the Palembang itself. Malay forms in *mp* are such as *ampang*, a *float*, *ampuhan* and *lampang*, a *flood*. The Malay words ending in *ang* and *bang* remind us not a little of similar terminations to Australian words. But further : the euphonious names in *mbr*, in so far as they indicate connection with water, run parallel with words of Greek, Latin, and Gothic stocks. There is the Greek *ombros* a *shower*, with its near relative in Latin *umber*, also a *shower*. Moreover the *Ambrones* were so called as being *river* people, just as *Umbria* seems to have been so called as being a *river* country. In fact, forms in *mbr* are of special interest. The existence of words of this form in different languages and among different peoples in Europe, is held as pointing to a very important fact in the history of the human family. It is held that this form *mbr* must have been in existence while the human race were associated together in Asia, and therefore before that dispersion whereby the form was carried to different parts of the world. But still farther as to the illustrative names in Europe : *Amber*loo is the meadow of

the *water*; *ambra* is another name relating to *water*. So also as to such names as *Ammer* and *Emmer*; these last would be formed from such originals as *Amber* and *Ember* by the regular and well-known law of assimilation. According to this law the words in question might become either *Ammer* and *Emmer* or *Abber* and *Ebber*.

River names in K, MB, L, N, R.

Hitherto we have had as the basis of operation root-words for water in the forms *m* and *mb*, with their phonetic equivalents. Or taking *m* to represent the very beginning of the stream, *b* comes in as an important tributary. Gathering strength as it goes along, a tributary joins the combined currents in the shape of the initial aspirate or guttural. Incidentally, some examples have come before us already, but now they appear directly on their own account; thus we have the names *Cambalong* Creek, *Kiambla* Creek, *Eucumbene* Creek, *Gambenamy* Creek, *Cumbo*rah Springs, Galla*gambroon* Creek, Bun*gambra*wartha Creek.

Looking now to other languages, we find the forms *Comber* and *Cumber* meaning a *confluence* of streams employed in the Celtic languages. *Cumber*nauld just means the *meeting of the streams*. The names *Kemper* and *Quimper* in the west of Europe have the same meaning. *Kember*leach in Brittany means the place of the *confluence*.

B, (Non-imitative.)

Root-words for Water in Ba, Pa, Wa.

After finding tributaries to the stream which started with *m*, and also after finding something analogous to ana-branches in the liquids *l*, *n*, *r*, we now come to a marked division in the waters of the stream, to the formation of a delta where two or more main streams flow separately. For, notwithstanding all affinities, the *m* can stand alone, and so also can the *b*. The first point has been already illustrated; and the other comes before us now for proof to the same effect. But more than this, we are now crossing the very line at which great discussions have taken place regarding the origin of language, for in *m* we have an imitative root to signify *water*, but not so in *b* or its phonetic representatives. The *humming* sound which pertains to *m* does not pertain to *b*; nevertheless, as we have seen, the one letter in certain circumstances introduces us to the other. The fact here developed is of obvious importance in drawing the boundary lines determining how far the influence of the imitative principle extends in the words of a language.

Proceeding with our inquiry, we have now to contemplate the fact that root-words in *b*, *p*, *w* for water are very numerous although not imitative of the sound of water. *B* as a labial may,

indeed, be regarded as having more softness about it than dentals, sibilants, and gutturals. In that respect it has a fitness for being shown to represent water; still, it is not to be regarded as having the important imitative element in any such way as pertains to *m*. Searching the vocabularies, we find the simple form *oba*, *water*, with variations, such as *oboit* and *obait* about Port Essington in the north-west. At Cape York there is *epi*, meaning *fresh water*, and *bubba*, meaning a *stream*; still at Cape York is *upu* meaning a *chain of ponds*. In Western Australia there is *appa*, *water*, and in South Australia, *apa*, *appa*, *appu*, *appy*, all meaning water. But now further, *b* and *p* in other languages, by ordinary course of phonetic wear and tear, soften down to a mere vowel sound, or to a sound represented by *w* or *r*. Have the aborigines displayed the same tendency in the words used to designate water? We have seen the abundant use of the forms in *b* and *p*; how does the matter stand at the point now raised? The vocabularies soon settle that question, for we find the forms *ow-wa*, *awrie*, *owey*, *ouy*, all meaning *water* in West and South Australia. When we come to the gazetteers we find such forms as *Obi-obi* Creek in Queensland, *Bobo* Creek in the Manning district. This name, it may be noticed in passing, closely resembles the word *bubbu*, a *stream*, at Cape York. There is also *Bubbah-Bubbah* Swamp. Still, farther there is *Bobi*alla Creek, also *Boob*ala Creek in New South Wales; and closely resembling these, *Booby*-alla River in Tasmania. There are *Boo*mi and *Be*ma Creeks, Wingeca*ribbe* Creek and Swamp, Goadradig*bee* River, Ingeegood*bee* Waterfall, Umut*bee* Swamp, Wollon*aby* Creek, Mun*yibbee* Creek, Werri*bee* River, Wallia-*nippie*, native name of Smoky Bay in South Australia. In the softer form such examples are found as Wal*owa* Marsh, Gool*wa*, a name of the Murray River; Curro*wa* Springs, Matte*wae* Fort Denison, Stel*owie* Creek, Nep*owie* Creek, Nar*owie* Creek. To these may be added *Eba* and Pul*bah*, names of islands, one in South Australia, the other in Lake Macquarie, New South Wales. These are noticed now because as we proceed the evidence will multiply that islands, headlands, and meadowlands have received names from words which have reference to water, the same thing having occurred in ordinary course in other parts of the world.

But turning now to other parts of the world, we find as follows: In the venerable Sanscrit, as also in the Persian, is the form *ab*, meaning *water*. In the Celtic is *abh*, *water*; *abi* is river in Turkish; *bi* and *bu* mean *river* in Ugrian; *obu* is *river* in Pushtu; *be* and *bu* occur in African dialects for *water*; while in South American dialects the forms *beai* and *eubi* mean the same. Pun-*jaub* in India is the country of the five *rivers*. The forms in *p* are also numerous. *Apu*, *water*, is Sanscrit. *Aph*, *water*, is found in Beloochistan. In the west of Europe, numerous streams whose names end in *p* are understood to embody the same root: thus Bar*op*, Lenn*ep*, *Oppa*.

The forms in *ra* have been illustrated so far as the vocabularies of Australian dialects are concerned. Turning to the gazetteers we find *Awaba* the native name of Lake Macquarie, Merri*wa*, Boorowa, and Williwa Creeks. Wammera*wa* is the name given to the marshes into which the waters of the Macquarie River expand. Goolwa is a name given to a part of the Murray River. Similar phonetic peculiarities appear to have been as fully manifested in other lands and languages. The Dan*ube* is found as the Don*au* on German maps. Here there can be no doubt about the connection between the two forms. The real root obviously is identical in the two cases. Loch *Aw* in Scotland and *aw* in Ireland illustrate the same point. *Aw* is *water* in Kurdish and Persian. *Wa* is *water* in Paropamisan, *wa*ha in Humarie. The form *wai* is Malay and Polynesian. *We*, *water*, is Papuan. *Awa*, a *river*, and *wai* occur in Maori: Dhala*wai*, a *pool*, is Feejeean, also *nawa* to *float*. *Vai* is *water* in Rotumah, and the forms in*wai*, ta*wai*, and ti*wai*, meaning *water*, occur in the islands of the New Hebrides.

Names of Streams in Bar, Par, War, Mar.

The counter processes of lengthening and shortening could be well illustrated by tracing the history of names. Short words are lengthened, and long words are shortened. A process of growth and decay takes place. Although we have got a world-wide root in *b* and its phonetic equivalents for water, yet few of the tribes of the human family were content to stop with that. In dealing with the leading channel for water, names connected with *m*, we found the effect of the fact that *m* had a natural affinity for *b*, and *b* came in very copiously, though not possessing the imitative qualification. At the present point, it is rather a principle of natural selection that operates. There is no such special affinity between *b* and *r* as there is between *m* and *b*; yet *r* has independent qualifications in the circumstances. If *m* represents the *humming* sound, *r* represents the *vibratory* sound, which makes it a very suitable letter to be used in words intended to denote water. We shall accordingly find that forms as summarily represented by *bar*, *par*, *war*, and *mar*, are pretty extensively employed to designate water. The very form *bar*, pure and simple, is found meaning a *river* at Lake Hindmarsh in Victoria. Other forms are numerous as *buar*, *boar*, *burong*, also meaning *river*. In Kamilaroi language, including the north of New South Wales, and the south of Queensland, the form *boar*ing is found meaning *rain*.

As to forms in *Par*, the root is found pure and simple in Victoria, meaning a *river*; also *proah*. At Adelaide is the form *parri*, *river*, a component of Onka*par*inga, a sounding name of a river in South Australia. More exactly, however, the native name was Ngauki*parri*. At the lower end of the Murray, *par*nar means *rain*. Also *poorai* means *rain* at Eden, in New South Wales.

As to forms in *War*, with the ordinary variations, there is *war* or *woor* at Cape York for *sea*. At Brisbane, there is *war*ril for *river*. There are *wooree*, *sea*, *wurran*, *river*, *war*ren and *war*ing, *sea*, in Victoria. *Wirra* is *rain* at Port Lincoln, in South Australia.

As to root forms represented by *Mar*: there is *mor*nee *rain*, at Port Darwin; *mor*ala is *sea* at Mountmorris Bay; *Mara* is a pool at Port Lincoln, South Australia; also *mir*rara a *swamp*. *Murr*ian, *sea*, is also found.

So far the vocabularies; now for the gazetteers. Forms in *Bar* are *Bara* Creek, *Baroo* Creek, *Barr*aba Creek, *Beri*co Creek, *Bor*en Creek, and dozens more. Forms in *Par*, *Para* Creek and river, *Para*bel Creek; *Para*ta Creek, *Paroo* River *Prooa* Lake, in New South Wales. *Parrie*poolan Creek, *Parga* Creek, in Queensland. Nganki*parri*, the real aboriginal name of what is called the Onkaparinga. *Para*barana Creek, *Para*lana Creek.

Along with this are to be mentioned the Karrauwirra*parri*, or River Torrens, Murta*parri* creek. Warri*parri* the Sturt River. Also the *Para*bana and *Para*lana Creeks, Bulla*par*inga creek, all in South Australia. *Para*it and *Par*wan Creeks, in Victoria.

Forms in *War*: *Warrah* Creek, *Warroo* Creek, *Warra* Wanda Creek, *Warr*ego Creek, *War*amba River, *War*lero Brook, *War*ialda Creek *Warra*dugga Creek, *Warra*gamba River, *Warr*ego River, *Warre-warrah* Creek. To these may be added *Warra*burrabri Island, in the Clarence River, and *War*autee or *War*dong Island, in South Australia, as again illustrative of the fact that root-words for water are employed to denote islands. Forms in *Mar*: *Mara-Mara* Creek, *Marra* Creek, *Mar*ara Creek, *Mar*aba Creek, *Mar*agle Creek, *Mar*galong River, *Mar*ool Creek, *Mar*oombile Creek.

It remains now to produce anything parallel to the foregoing from other parts of the world. Following the same order, there are forms in *Bar* to be looked for. *Beer*, a well, is Hebrew, with *bir*, the Arabic form. *Bior*, Celtic, is *water*. There is also the root form *vahr*, in Arabic, meaning *lake* or *inland sea*. *Bahr* Lut is Lot's Lake, or the Dead Sea. *Bahar*-belame is the waterless *river*. *Bahari* designates a *maritime district*. *Bahrein* denotes also a group of *islands* in the Persian Gulf. Here we have a cluster of illustrations of the point already noticed, that root-words meaning water are often used to designate islands, headlands, meadows, or lands bordering on water. The form *bar* occurs, meaning *water*, among the North American tribes. Among the Malays, *Bar*una or *Var*una is the regent of the *sea*.

Forms in *Par* have also a very wide distribution. *Per*ath is the earlier form of the river which was enlarged by the Greeks into the Euphrates. But to this day in the East it is called *Abi Frat*, *River Frat*. *Pharpar*, one of the "rivers of Damascus,"

embodies twice over the form with which we are dealing. It was the form *par* that struck the traveller Humboldt among the rivers of South America. As names which had been given to the Orinoco, he found such as these, Yuya*pari*. Huria*paria*, and Cra*pari*. In these and other instances he thought he could recognize the radical form *par*, meaning *water*, in parts of the continent widely separated from each other. *Para* means rain in Peru; *parani* to rain. *Pariu* is a *lake*. In Carib, *parana* means a *sea*. *Para*, *Pari*, and *Parana* are names of rivers in South America. ***Pari* also means to flow, as the *tide* in Maori.**

Forms in *War*, very numerous in Australian geography, are illustrated by examples of that root meaning *water* in some of its aspects in the Malay and other languages. *Wayr* is *water* in Malay and Papuan: *wayr* is *water* in Polynesia: mu*wara*, the mouth of a *river*, is Malay: *war*, *water*, is Malay: *wer*, *warari*, *wear*i, meaning *water*, are found in New Guinea.

The form *War* brings us at once to the Latin *mare*, *sea*, the root of many words in the countries of Europe on which the Roman language was so deeply stamped. The same root, as *muir*, appears in the Celtic family of languages. There are also the Teutonic forms in *mere*, *meer*, as Thirl-*mere* and Rydal-*mere*. Words represented by the English *marsh*, but which occur in Scandinavia and France, belong to the same large family. *Muran* is a river in Mongol, and *Mori* a *lake* in Ugrian. *Meren* is a *sea* in Malay, and ***miri* to *rain* in Feejee.**

With these materials we conclude one section of our work. The stream starting with *m*, which we have followed, with its affluents and delta arrangement, drains about one-third of the whole area to be examined, that is confining our attention at this point to the Gazetteer of New South Wales. We have, indeed, not by any means taken up all the smaller currents flowing into the main stream which would have to be considered in an exhaustive investigation; yet the area operated upon may be represented as including about 250 of the rivers and waters which make up the total of nearly 800, which occur in the New South Wales Gazetteer. One conclusion, so far, is pretty plain, that there is broadly a very notable analogy existing between the aboriginal principles and method of dealing with names for rivers and the principles which have been seen to prevail so extensively in other **parts of the world.**

N, NG (Imitative).

We proceed now to trace the course of another stream, which drains a large area, as regards aboriginal names for rivers and waters, the representative letter now is *N*, one which has close kinship to *M*, already considered. It belongs to the imitative class of letters. It is well fitted to indicate the *din* of the waters, as *n* sets forth

the *hum*. In the simple form *n*, the root-words indicating association with water are not numerous. There are such as *nano*, a *swamp*, in Western Australia ; *naoi*, a *canoe*, in the neighbourhood of Port Jackson, It is when we take *n* in conjunction with *g* that a flood of illustrations pours in upon us. For, as *m* has its natural affinity for *b*, so *n* has its natural affinity for two classes of letters, the gutturals *g*, *k*, and the dentals *d*, *t*, we shall follow out the illustrations in connection with the nasal *ng* and *nk* sounds. At Cape York there is *ung-onya*, *salt water* ; nar*ung*, *lagoon*, about the Manning River ; *ngar*ugi, to *drink*, in Kamilaroi, north of N.S.W., and south of Queensland ; *ngay*uwa and *ngat*ing, *fresh water*, at Lake Macquarie ; ya*ang*, *lagoon*, Victoria ; *nguke*, *water*, at Lake Alexandrina ; *ngarru*, *breaker*, at Port Lincoln ; *ngyanga*, *ware*, in Western Australia ; *ngur*a and ur*ingo*, a *pool*, at Champion Bay, Western Australia. Along with all these may be given *ngarong*, meaning an *island*, as showing again how root-words for water are used to denote islands.

Forms in *nk* are such as these : *Nuken*, *river*, Moreton Bay ; *nukon* and *nuko*, *water*, Lower Darling ; *nguk* and *ngukko* on the Lower Murray ; *nucho* on the Murray ; *tuinke*, *swamp*, at Lake Alexandrina. The word *killink* is specially imitative, as describing as well as denoting the sound made by a stone when allowed to fall plump into the water.

Looking now into the gazetteers for illustrative names, there occur Beler*inga* Creek, Carral*unga* Creek, Mypo*nga* River, Kay*inga*; Lake Alexandrina ; Ald*inga* Lagoon and Bay ; Bullapar*inga* Creek, Coro*ng* Lake, Pandlot*inga* Creek, Toorar*inga*na Creek, Wildan*unga* Creek. Besides such as these, there are the streams of names ending in *long*, *rong*, and *gong*. Those ending in *gong* will be more specially examined hereafter. As between the forms in *ng* and *nk* there may be noticed in passing a notable result. Out of nearly 800 names of rivers and waters in the Gazetteer of New South Wales, upwards of 100 contain the nasal *ng*, while only a few units exhibit *nk*. Of this last class are such names as *Yanko* Creek. In South Australia there is *Yanka*lilla River.

Looking to other languages of the world, we have the nasal in the Shemitic *ngahyin*, a fountain. This is the word which, shortened into *ain* and *en*, so often indicates the locality of wells in books of Eastern travel. *Ayun* Musa, are the wells of Moses. There is *sungei*, a *river*, in Javanese ; *arung*, to *wade through water*, in Malay, also *ongogu*, a *river* and *ngusor*. In Maori, there are *ngaehi*, *tide* ; *ngaeki*, *swamp*, and *ngongi*, *water*.

K (Non-imitative).

Root-words for water in ka, ga, ya.—In pursuing our inquiry we come now to a point precisely parallel to what was encountered after starting with the letter *m*, as supplying a root-syllable for

expressing *water*. We pass the boundary-line between imitative forms and those which are not. Forms in *ang* and *ank* are imitative, but forms in *ag* and *ak* are not; indeed, here we have a sudden and complete reversal of the idea of the imitative principle. In the case of *m*, which brings us to *b*, a labial, we have a comparatively soft class of letters to deal with. But *k* is one of the hardest letters in the alphabet. It suits well for such words as *hack* and *tack*, but on its own merits it is one of the last letters that would be chosen to denote water. Yet we see how such forms as *anga* and *anka*, by regular phonetic law of assimilation, are transformed into *agga* and *akka*, forms which were notably imitative of the *singing*, *ringing*, sound of waters, into forms which **are quite the reverse.**

Then in the language of the aborigines who have shown, as we have already seen, a strong disposition to use euphonious names for streams and waters, how does the matter stand when we come to such hard forms as *k* to represent water? The illustrations of the form are numerous enough, and seem to prove that language flows in a channel, and according to laws which operate and assert themselves even against strong opposing elements. Thus, we find the hard root for *water* pure and simple in such words as *ook*, *ooko*, *aeah*, found on the Darling and Murray. There is *koko*in, water, at Lake Macquarie; also *koi*won, *rain*, at the same place. *Ugou* means *flood*, also *uuka*wa, in Kamilaroi; *auke* is *water* at Port Darwin; *uki* and *nuki* mean fresh *water* at Massied, a small island in Torres Straits, though nearer New Guinea than Cape York. As to names in the gazetteers, we look for forms in *ku*, *gu*, *gu*, or their phonetic representatives. There is the Koko Creek, the *Kiah* River, Bega, or Bem*boka* River, Bar*go* River, Mica*lago* Creek, Boi*ga* Creek, Cowri*ga* Creek, Cul*goa* River, Dundarala*go* Creek, *Nacka Nacka* Creek, *Nagha* Lake, Peri*ca* Creek, Towa*ca* River, Tun*go* Creek, Umban*go* Creek and Swamp, Pai*ka* Lake, *Yauk* Creek, Paru*ka* Lake, Wondow*gee* Creek. To these may be added Yar*gai* Island, in the Clarence River, again illustrating that the same root-words **are used for waters and islands.**

Besides all these, there is one notable name which occurs in the gazetteers upwards of a score of times. It is the name *Oakey*, applied to creeks. It might be surmised for a moment that this is some British name, but the frequency of its occurrence and its wide dispersion in New South Wales and Queensland render this impossible. Thus, in Queensland there is Oakey Creek in County Aubigumy (twice), in Canning, Cavendish, Clinton, Cook district, Newcastle county, Normanby district, Springsure district, and county Wicklow. In New South Wales there is Oakey Creek in counties Ashburnham, Bathurst, Darling, Dudley, King, Murray, Napier (twice), Roxburgh, and Wellington. Here it

can scarcely be doubted for a moment that in all these cases *oakey* simply meant *water*.

In now looking beyond the Australian Gazetteer the root in *k*, or its equivalents, is found extensively. It occurs in the Latin *aqua* in the former part of the word; it occurs in the old German *aha*; and in the first syllable of the Gothic *ahva*, *water*. It also appears in the Old French *ax*. The root is embodied in such names as *Saltach*, *Wertach*. *Aachen*, the German form of the name *Aix*-la-Chappelle, doubly illustrates the point at issue. The chapel was built at the locality of the mineral *waters* where Charlemagne was buried. The root is wide-spread also in the Celtic family of dialects, as in uis*ge*, is*ge*, the Gaelic and Armoric words for *water*; *kya*, *water*, is Nepaulese; *acho*, *akwo*, *agho*, *ek*, *water*, are African; *aki* and *akei*, *water*, are Malay; *gia*, *rain*, is Polynesian; *ok*, to *drink*, is Curnicobar; *kau*, *sea-coast*, *pokaka*, a *shower*, are Maori; *ko*, *okah*, *kha*, *ocquie*, *water*, occur among the North American tribes; so also *kuik*, *river*, eu*kehi*, *lake*, *ko* and *kaya*, *rain*. *Ak* and *kioko*, *water*, belong to Texas; *qo*, *ochke*, *akwaken*, *water*, *ukwii*, *rain*, are found in tribes of North-west America; *yacu*, *water*, is Peruvian; *cuqua*, *yge*, *yg*, *aqua*, *ochi*, *ko*, *water*, are found among South American tribes.

So far, we have followed the course of two of the chief channels in which the aboriginal names for streams and waters have been found to flow. The two put together account for about half the river names in the Gazetteer of New South Wales. There is indeed the combination of the nasal *n* with the dentals *d t*, but the illustrations at this point are not nearly so numerous as in the combination of the nasal with the gutturals *g k*. Including the dental combination with *n*, nearly two-thirds of the names in the New South Wales Gazetteer are accounted for, leaving the remaining third to be made up of the less euphonious combinations with dentals and gutturals as well as the intermediate labials.

Combination of the roots ka ba.

Before we leave the forms in *ka*, *ga*, *ya*, there is a point which may be properly considered. It is the combination of the two roots represented by *k* and *b*. Thus we find *ca-pe*, *ca-pi*, *ga-be*, *ga-bbi*, *ku-yp*, *ky-pe*, *kuy-pa*, *ky-pi*, *ky-pbi*, *ki-op*, all meaning *water* in Western Australia; also *ca-ppy*, *ka pi*, *coo-bie*, *water*, in South Australia. In all these forms the combination of the *k* root and the *b* root, with their equivalents or variations, is quite evident. Moreover, these roots appear in connection with the names of places where water is to be got. There is Wademar *Gaippe*, Berinyana *Gaippe*, Beelimah *Gaippe*—places where water is to be got by digging in the sand. To the same list belongs Yeer Kumban *Kaaure* at the head of the Great Australian Bight, which, as well as those already mentioned, were on the track of the traveller

Eyre, on his perilous adventure from South Australia along the coast to Western Australia. In this last instance *Gaippa* appears as *kaaure*: but this is in strict accordance with the phonetic laws which have already been so frequently exemplified. In the labial letters we run down the scale thus: *ka*, *pa*, *oa*. But this is abundantly shown by other examples. In South Australia there is the common form, *co-rie*, *water*, spelt also *ko-ue*, *kau-ri*, *ko ee*, *ko ee*, *kau-ee*. At Port Lincoln the two forms are found, namely, *ka pi* and *ka-uo*, lake. *cope cope* or *gope-gope* is the same word, and the lake is so called because it drains the waters of the district. The common form, *coo-ee*, in South Australia, used to denote *water*, reminds us of the far famed Australian call, "*coo-ee*," and the question arises, can there be any possible connection? Considering the multiplicity of dialects throughout Australia, how has this one form of call succeeded in establishing itself among so many tribes? In the sandy region of South Australia, when an anxious search for water was successful, the loud and joyful cry to the members of the tribe at a distance would really and literally be *ko-ee*—*water!* Indeed, in ordinary course, we have the record of something of the kind. Bishop Salvado narrates how he and his company were disappointed by not finding water where it was expected, and had to spend the night in a very uncomfortable manner. Next morning an aboriginal attendant guided him to another place where water might be found; but here, too, there was none. Still a third place was sought; and here the precious element was obtained. After the manner of the savages, he says, there was now sounded the loud *Cu-i*, as he spells it, to those who were behind. The word meant "*water*," as well as "*we are here.*"

But returning from this digression, it remains to notice that the peculiarity which has now been illustrated in the combination of the two roots for water among the Australian aborigines appears to have taken place in other parts of the world. Thus the Latin *aq-ua*, *ah-ua*, *ah-ba*, have all the appearance of being a combination of the same two roots, for we have seen that in Europe these two roots are widely distributed in the names of streams. In the combined form also they appear to have supplied names for numbers of places. Thus, the present *Vaaire* was in ancient times *Aquaria*, the water country. *Aqui*tania was the land of rivers or waters. Numbers of names of places in ancient Gaul are adduced as containing the root *aqua* as the foundation of the forms into which they have been shaped in the course of time. Besides the Latin *aqua*, there is the Gothic *ah-va*, *water*. Here again appears to be the same combination of guttural and labial as in *aqua*, for the aspirate *h* is closely akin to the gutturals. The subject of a plurality of roots, each meaning *water*, and making up one name applied to water in some shape, will receive further illustration as we proceed.

River names in Bad, Wad.—Although we have taken up leading channels in which the aboriginal names are found to flow, yet there are more isolated cases which yet have made a prominent place for themselves in the gazetteers of the Colonies. One of these is the form in *bd*, *bt*, with the forms which according to phonetic law arise from this source, namely, *pd*, *pt*, *wd*, *wt*. The most important, however, are the names of which *bad* and *bat* as well as *wad* and *wat* may be taken as the representatives. There are *badto*, *water*, and *bodo*, *rain*, at Champion Bay, in Western Australia. *Budo* also is *water* at Port Jackson; *bato*, at Lake Macquarie. This word *budo* is recorded by three of the earliest vocabulary writers, Tench, Hunter, and Collins. The forms *bato*, *batoo*, *batu*, and *battu*, are also found. When we turn to the maps and gazetteers, we find a *lake* called *budda*. Also, we have one of the more important rivers of New South Wales called the Murrumbidgee. This simply means the big *water* or *river*. Other illustrative names are such as *Bat*maroo Creek, *Beth*ungra Creek, *Boto*bolar Creek, *Butheroo* Creek, in New South Wales. Burrum-*beet* Creek and Lake are in Victoria.

As to root words in *wad* or *wat*, or their equivalents, we have ga-*wata*, a *swamp*, at Cape York. *Wadi*, to drink; pa-*wat*, a *swamp*; kooee*wreet*, *rain*; *wad*by, to *swim*; as also *wat*pulir and *wid*yara, to *drink*, all in New South Wales. As to names of rivers, there is the Cale*watta*, a name of the Darling, Arra*watta* Creek, *Watte* Creek, *Watta* River, *Watta*wa Creek, *Wat*agan Creek. Here again it is impossible to avoid the conclusion that to the inhabitants on the banks of the different streams the *watta* was just the *water*. In Tasmania the form *wattra* is found joined to a river. There is the *Wattra* karoola, Piper's River. As to *Karoola*, it may just be noticed in passing there is the *Karaula*, on the borders of Queensland, where Mitchell camped for some time, and there is an Ar-*Caroola* Creek in South Australia.

Looking beyond Australian boundaries, we find the root now discussed to have a wide range of existence. The form *hedu*, *water*, has been preserved to us as an old Phrygian word. There is the Sanscrit *patum*, to *drink*; the Latin *poto*, and the Greek *kotidzo* I give to *drink*; *poti*, to *drink*, Selavonic. Also, the German *bad* and English *bath* belong to the same extensive connection. *Budo*, *water*, is an African form, and *butean* is *water* in Samarang. *Wad* and *wat* have also a very ancient and wide existence. *Udus* *wet*, Latin, and the word *wet* in English as well as the Sanscrit *udum* belong to the same root. *Wadi* is a *watercourse*, Arabic. *Udama* is *rain* in the Malay Archipelago. *Udha*, *rain*, *wadha*, low *water*, *adhi* wai, creek, are Feejeean; *wat* and *wit* occur frequently in North West American words for *water*. *Wata*, *water*, occurs in New Guinea; *wato* is Gothic, *voda* is Russian, and the forms *ouata* and *wat*, for *water*, are African.

River Names in Yar.

There are three more important roots for river names in Australia, to which attention will be shortly directed. There are *yar*, *gong* and *kal*. These will be taken in their order. Following the usual method, we shall consult the vocabularies for proofs that the form is applied as a radical one, meaning water. Thus, *yur*ong, *rain*, at Moreton Bay; *yuro*, *rain*, in New South Wales; *yuri*, to *pour*, and *yerro*, *water*, occur at Lake Macquarie; *yarn*, *yarr*am, *yerr*am, and *yarr*an for *river*, *sea*, and *spring*, are in all parts of Victoria; *yer*lo is *lake* at Adelaide. Turning now to the gazetteers, the illustrations are numerous. Thus, in Victoria there is the notable *Yarra-yarra* River, the meaning of which was ascertained at a very early date to be *flowing-flowing*. There is the *Yarra* rivulet, *Yarr*ayne, the aboriginal name of the Loddon River, *Yarr*iambiac Creek, *Yarr*owee River, *Yarr*um Creek. Then *Yer*ang Creek, *Yer*ing Lake. Turning to the Gazetteer of New South Wales we find, *Yar*enaigh Creek, *Yar*imba Creek, *Yarra*-low Creek, *Yarr*an Creek, *Yarr*angobilly Creek, *Yarr*ara Creek, *Yarra-Yarra* Creek, *Yarr*en-*Yarr*en Creek, *Yar*imgah Creek, *Yar*-dowindidja Creek. Here again we find a root-word for water applied to an island, as *Yar*gai Island, in the Clarence River, and *Yer*unu, name of an island in South Australia. Besides all these, there are forms in which the *yar* is not at the beginning of the name.

Turning now to other parts of the world, we find the forms *Yaro* and *Yero* remounting to a venerable antiquity as very early Egyptian names applied to the Nile. There is also the Hebrew *yor*, which means a *river*. In the British Islands a number of streams appear embodying this root, the *Yarr*ow, the *Yair*, the *Yar*, names which so closely resemble those already adduced as existing in Victoria and New South Wales.

River Names in Gong.

Here is a form which is common to mountains and streams. As to mountains we have such names as the Warra*gong* Mountains, Bo*gong* or the Round Mountains, the Merri*gong* and Mitta-*gong* Ranges, Carcal*gong* and Mundaru*gong* Mounts, as well as others. But there is also a goodly array of *gongs* from the side of the waters. There are Burran*gong*, Cudge*gong*, Bron*gong*, Kallobun*gung* Creeks, Wa*gonga* Inlet, Tra*gong* Creek. In such forms as the following the *gong* or some equivalent is also plain enough—Bon*gong*along Creek, *Gang*angar Creek. *Kanga*loola Creek. Also the forms in *y*, Noe*yango* Lake, *Yango*, *Yanko*, *Yengo*, *Yonga* Creeks. Now leaving the mountains aside, we have to see whether there are any root forms in *gong* or its equivalents meaning water. The vocabularies supply us at once with

such words as *kung* or *kong*, meaning water at Moreton Bay, and *kong*un, *water* on the Peel River. The forms *guong* and *guang*, *rain*, occur at Wellington. *Kuiung* at Illawarra means *sea*; in compound words tura*gung* at Port Jackson meant a *creek*. Nulla-*kongg*or in Kamilaroi means a *waterhole*. At Illawarra ngait-*yung* is *water*. Na*gung* is *water* at George's River. These materials prove abundantly that there is a root-word for water which may be represented with its variations by the form *gong*, which occurs in the names of so many creeks and designations for water. When we look beyond the Australian area our attention is arrested by the great River *Ganges* in India. This name was formed just in the way which seems to have been universal among the Australian aborigines. The word *ganga* or *gunga* is the Sanscrit for *river*. To those who settled in the far back ages upon its banks, it was simply the *river*. So, after all the illustrations which have been given that the same radical form exists among the aborigines here, we cannot doubt that such names as appear in the gazetteer as *Congai*, and *Gung*ulwa and others, just meant the *river* or the *water*. Besides the great Indian *Gunga*, which means *river*, it should also be recorded that in the Chinese, at Shanghai, *kong* is the name for *river*.

River names in Kal.

The vocabularies here also supply abundant evidence that forms in *kal*, *gal*, *yal* or their equivalents are used as root-words to denote water. Thus Mitchell in the district of the Bogan records the forms *kally*, *gally*, *gallo* as meaning *water*. *Calle* is *water* at Regent's Lake; *kally*, *rain*, and *kollee*, *water*, in New England; *kaling* is *water* at Lake Macquarie. *Kuli*man, a *tub*, is the *water*-holder. *Gol-gol* is the word for a *spring*, as well as the name of a creek. When we come to names of streams, we find that there is the *Coola* Creek, the *Col*oola Creek. Moreover, the aboriginal name for the Lachlan River was *Cul*are; for the Peel River, *Callal*a; and one of the names of the Darling was *Cale*watta. Also, one of the names for the Murray was *Gool*wa. In all these cases applying to the Peel, the Darling, the Lachlan, and the Murray, we cannot doubt that to the inhabitants on the banks of the respective streams each of them was simply the *water*. When we look beyond the Australian boundary we find *Khola* is a *river* in Tamul; *Kul*, a river in Cashmerian; *Kuli* is a *brook* in Javanese; *Golem* is *rain* in the Malay Archipelago; Ta*lathi* is the *sea* in Feejee.

Plurality of Root-words for Water in the same Name.

As we have passed along, some indications have transpired to the effect that the name of a river, or a word for water, was really made up of two separate roots, each meaning water. There is

the notable case of *Courie*. From the multiplicity of forms and spellings in which this word is found, there is no doubt that it contains the two roots represented by *k* and *l*. Also, there is no doubt, from the evidence adduced, that these do represent two roots which have entered extensively into the names of streams and waters over the whole of Australia. But, does the gathering up of several roots into one name extend any farther? For example, there is the formidable name *Yeer kumben kaure*. This is not the name of a large river or ocean; it is the name of water covered with sand, at the head of the great Australian Bight, which was reached by Eyre on his perilous adventure from South to Western Australia. Now, here plainly we have the *kaure*, but what of the *yeer kumban*? After the materials which have been reviewed, we have little difficulty in identifying *yeer* as an old friend and near relation of the large families of *yars* and *yers*, which have come under our notice. Here then is another root meaning *water*, *yar* added to *ka* and *wa*. So also of the form *kumben*; as a root, we find it in the vocabulary of Bishop Salvado associated with water, and we have seen how largely the sounding syllables enter into names of creeks and waters. Still further, Kumban is a name which occurs in Indian mythology. It applies to a potentate who is identified with one of the signs of the Zodiac, and the significant point is that the sign is *Aquarius*, the *water-bearer*.

Here there are four different roots, which, with very little room for doubt in the case, have been agglomerated together in the course of successive generations by the aborigines. More of the long names seem to yield easily to resolution into their primary elements. There is the jingling name *kalingalungagay* for a creek. Now, here we can have little scruple in setting down the *kaling* and *kalung* as the same word repeated, and we know that the forms are conspicuous in the vocabularies as meaning *water*. Then, as to the last part of the word *gaygay*, the mere pronouncing of the syllables reminds us of the well established root in *ga* or *ka*. This also is repeated as in the case of the former part of the name. Yet again, there is the *Galla gum broom* Creek. This yields easily to analysis in view of the examples which we have had in the foregoing pages. Forms in *gmbl*, *gmbn*, and *gmbr*, seem almost interchangeable. Their association with forms employed as designations for rivers and creeks has been fully illustrated. Then as to *galla*: that is one of the well-established roots for *water*, and is embodied in the form *kaling*, which we have just been considering in connection with another word. Yet again, there is the formidable name of a spring *Widge galla gambone*. But here the *galla* and *gambone* were disposed of in the name dealt with immediately previously. The only part remaining is *Widge*; but this is evidently of the *Bad* and *Wad* connection, meaning *water*, like the *bidge* in Murrumbidgee.

Now, when we go beyond the Australian tribes, we find that other people have done the same thing. Thus, in the north of England we have such a stream as *Wansbeck Water*. Now, *wan* or *vand*, and *bec*, are Scandinavian words for *water*. To the two words, each meaning *water*, the English word *water* is added, making up a repetition of the same radical idea three times over. But this matter dovetails into questions of historical interest. Thus, we know that the little river *Yair*, in Norfolk, was called *Gariemus* under the Romans, though it has resumed its original or aboriginal name. Now, *Gariemus* has every appearance of embodying the Celtic *amhainn*, river, in the Manx form *aon* the origin of the *arons* that are found as the names of streams in the British Isles. But this addition of *amhainn*, *river*, to the primitive form *gar* or *yar* comes out more plainly in the case of the *Garonne*, in France. *Gar amhainn* has every appearance of supplying the original which Cæsar converted into *Garumna*. But as both of the roots conjoined here belonged to languages foreign to the Romans, he added to *Garumna flumen*. Thus, as in Wansbeck Water, we have three different roots amalgamated together, meaning *water* or *river*. Now, the point of historical interest is that these metamorphic processes form some sort of index to the migrations or conquests of the people who are concerned in the case. Thus, suppose we start with the aboriginal *yar* or *gar*, for the *water*, the *river*, then *yar amhainn* indicates the advent and settlement of the Celtic race. Then the farther development into *Garumna flumen* is a remnant of the invasion of Gaul by the Romans. So also the *Garonne Fleuve* of the French maps of the present day is an index to the important changes which have taken place since the subversion of the Roman Empire. Now, on the same general principle, the time may come when such a combination of roots as appears in *Yeer cumban kaure* may enable some Australian investigator to trace the course of migration of the Australian tribes, at least in that part of the island continent.

Tasmania.

A glance must be taken at Tasmanian names for rivers and waters. Though only about half a dozen aboriginal names retain their places on the map, yet about seventy or eighty have been preserved in vocabularies and otherwise. We have here to proceed with caution as regards the Gazetteer; for, such names as *Illawarra* and *Parramatta*, and a number of really aboriginal names, have been imported by the white settlers from the Australian mainland. As we consult the vocabularies, the most prominent root for *water* appears in the forms of *l* and *la*. Thus *lea*, *river* or *lake*; *liah le*, *ocean*; *lileah*, water. In compound words and terms bringing in words associated with water, there

occur *liah*-pota, *river, creek ; lia*-mena, *lake , loa*-maggatangta, *deep water ; lia*-tarightea, to flow ; *lia*-larataine, *foam ; lia* wenee, *water ; lay*-ka, *wet ; le* areaway, an *island*, thus again illustrating what we have had so often in regard to the names of islands on the other side of Bass' Straits. In the longer form *la* we have *lina* or *linah*, the common word for *river ; liena* and *lena*, *water ; lena* also the *sea ; lenone*, lake ; *lienire*, fresh *water ; luina*, to *drink ;* wia-*line*, *exudation.* When we look at the names of rivers, the word *linah* is often appended just as we append *river* to the name by which the river is called ; thus, Kuta *linah* is the Jordan River ; Promena-*linah* is Brown's River ; Mangana-*lienta* is the South Esk River. Now again we find the islands re-echoing the word for water in their names ; thus, *Luna* mamae*lunnah* is Bruni Island, which contains the same radical form twice. Tiarerry meea *lonah* is Maria Island. The shorter form in *l* is to be seen in the following names of streams : there is *Lea*berryade, or *Lea*berra, Douglas River ; *Lillat*eah is Recherche Bay ; Moyente-*lea* is Toom's Lake.

The prevalence of the root form in *l* is notable, as it has not come conspicuously before us when dealing with the more important roots for water used on the mainland of Australia. In actual names it occupies a prominent place. Its imitative character is brought into requisition in naming a picturesque waterfall in Victoria, by the reduplicated form *Lal-Lal.* As quite a curiosity in nomenclature, there is the rather remarkable South Australian word

Warralillialilliallilia,

as the name of a *spring* of fresh water. It is worthy of notice that the forms *linah, lonah*, and the variations of the same radical form have a parallel in the Polynesian form *lanu*, water.

But there is another root from which have sprung a number of Tasmanian names relating to water. It is the root *g* or *k*, with which we have had much to do on the mainland of Australia. We find traces of it in such words as mo*go* mo*ko*, mo*cha* meaning *water, fresh water.* Also in such words as lay-*ka wet*, mayni*ack*, *rainy*, liemkane-*ack*, a drop of *water*, luggat*ick*, the *tide*, *kuka*mena-mena, *foam.* In the names of rivers and other waters it is found as follows : Leeaberry*ack* Douglas River ; Poyanannup*yack*, Oyster Bay ; Parraloongat*ek*, Macquarie Harbour ; Tungan*rick*, Arthur River. Now, besides these names applying directly to water, there are names of islands, headlands, and land on the sea-coast in which the same root occurs. Thus, Tittanari*ack* is Governor's Island ; Reen*eka* is Hunter's Island ; Muracomy*ack* is East Bay Neck ; Teeralinn*ack* is Eagle Hawk Neck ; Kenna*ook* is Cape Green ; Monatt*ek* and Romanra*ik* are two names of the conspicuous Circular Head ; also, Purr-*eka* is the name of a portion of the *sea coast* extending south-east from Circular Head Promontory. Now all these cases would fit

to the general rule that root-words for water are also employed to designate islands, headlands rising out of the water, land adjoining water, and meadow-land. In the present case, however, there is an *ek* which cannot be brought under any of the cases enumerated. It is Mebbe*lek*, the aboriginal name for Frenchman's Cap, a mountain too far inland to be regarded as a headland rising out of the sea. Of course, this might imply no more than that the same form of root was common both to waters and mountains. We had a notable case of the same thing in the *gong* form, so fully exemplified both ways on the Australian mainland. As to the *ek* root for mountains, we find it well exemplified in the Scandinavian geography. Thus there are Loms-*eggen*, Jukul-*eggen*, Skardals-*eggen*, and more. *Eggen* is the plural of *egg*, which again is akin to our English word *edge*. In the French there is *aiguille*, *needle*, a term also applied to mountain pinnacles, as copiously exemplified in the names of rocky spikes in the Mont Blanc group of mountains. In Latin are the cognate roots in *ac*, as *acuo*, I *sharpen*, *acus* a *needle*, *acer*, *keen*, *acies* an *edge*. In Greek also are such forms as *ake*, *point*, *akis*, *edge*, also *akoke* and *akme*. There is *ak*on a *dart*, with the Sanscrit relative *acan*, also a *dart*. Moreover, in Greek there is the adjective form in *ekes* to be added to words to give the idea of *edge*, as amph*ekes* *double-edged*. It may be mentioned that the form *mocha*, *water* in Tasmanian has a parallel in the same form *mocha*, *water*, in Western Australia, and at the extreme opposite corner, the form *muki*, at Massied, one of the small islands in or near Torres Straits.

Names of Islands and Headlands.

Numerous examples have occurred in the foregoing pages to show that root-words for water have often been used to denote islands and headlands. The principle of so applying names applies also to peninsulas, coast-lands, and meadow-lands. In all these cases the association with water is clear, The islands, peninsulas, and headlands rise up from the water. The coast is washed by the waters of the ocean, and the meadow-lands on the river banks are at times overflowed with the waters of the stream. Besides the individual examples which have already been adduced illustrative of the subject now under consideration, there are various points to be brought out. Thus, at Lake Macquarie we have *ngarang*, an *island*. On the Hastings this has become *gnarook*, which means both a *swamp* and an *island*. Now here we notice the operation of phonetic laws. The more flowing form in *ng* has hardened into the hard guttural *k*. But it remains that we indicate how the application of root-words for water in other parts of the world have been applied to islands and headlands. Thus the Greek *nesos*, an *island*, is from *neo*, I *swim*. The idea of an island

appears to be that of something *in the water*. The Latin *navis* and the Greek *naus*, a *ship*, are accordingly so named because they *float upon the water*. The Port Jackson word for *canoe*, namely, *nawi*, seems to have been adopted on the same principle. Further, the Latin *insula* appears to supply the same connection with *water*. *Insula* is something cast *in salsum*, *into the ocean*. Cognate with this is the Celtic *innis*, which applies to *island*, *landland*, *peninsula*, and *meadow-land*. There is *Inch*keith, an island. There is Dur*ness*, Doirbh-*innis*, Stormy Island, only the island in this case is a peninsula. Then there are the famous *inches* of Perth, in Scotland, which are *meadow lands*. Let it be noted also that the Greek *nesos*, an island, is applied to a *peninsula* in the notable case of the Peloponnesos the *island* (*peninsula*) of Pelops. In the Gothic stock of languages similar phenomena occur. The form *ea* in Anglo-Saxon is an *island* and also *running water*. *Eaton* is the *water*-town. Many places have names determined by their relation to water. In Scandinavian *oe* is *water*, hence *oeland*, an *island*, is *waterland*. *Zea*-land is *sea* land. In Germany, forms in *au* indicate meadow-lands, as on the banks of rivers. Thus Rhein-*au*, and many more.

Root-words for Water and their bearing on Grammar.

Besides the arrangements whereby root-words for water are used to denote islands and headlands, there is a trace of another development of language which may be noticed. It is a matter in which we possibly get a glimpse into the primitive operation of ideas which led to the formation of some of the grammatical peculiarities of language. In connection with all that we have had to notice about rivers and streams, and the circumstances of the aborigines in regard to them, there are some points which come to the surface enabling us to see how words have passed from the state of nouns to the state of prepositions, and how insensibly a process of generalization seems to have taken place in the aboriginal mind. But to proceed to the materials concerned. In a vocabulary we find that in two different dialects a camp is represented by the aboriginal words *koiong* and *ngurang*. The former means *fire*, and the latter means *water*. The association of ideas is simple enough. The *fire* is a source of significant and compendious reference to the place where the camp or settlement is established. So with regard to the indespensable article of *water*, the *watering* place is the *camping* place. Now along with this we put information which we get from the vocabularies. We are familiar now with the root *ap*, *op*, or *up* in Western Australia as very extensively concerned in the Australian names on the map for waterholes, springs, and wells. But we learn that *ap* and *op* become terminational particles added to names, to indicate a place suitable as a *resting place*. We have seen that the *watering place*

is the fit place for the *camping* or *resting place*. While in many cases rivers, as such, often a mere chain of ponds, are not designated by specific names, yet resting places are designated with great minuteness. Now, beyond doubt, the most important of these *resting* places were *watering* places. Hence then, to all appearance, the explanation of the numerous names in Western Australia ending in *up*. Thus, *up* as a root for *water* agrees perfectly with the information that *ap* and *up* are used as terminational particles to indicate a resting place.

But we have seen that numerous roots are used for water—does the same peculiarity transpire in connection with any more of them? This would seem pretty plainly to be the case. Thus in South Australia we have become familiar with the nasal sounds in *ng*. Now, in the vocabularies we learn that in South Australia the forms *ungai* and *angh* are used as prepositions where the idea of *rest* is signified. This obviously follows up very closely upon the heels of what we have met regarding *up* in Western Australia. Still further, it may here be mentioned that the addition *inga*, which is found in the South Australian river name *Onkaparinga*, has the same explanation. The form *inga* is prepositional (though here put after the word which it qualifies), and means *at* or *near*. Onkaparinga therefore means *at* or *near* the river concerned in the matter. Some names besides that of Onkaparinga have found their way in the prepositional shape into the maps and gazetteers. Thus *Bullaparinga* Creek, *Pandlotinga* Creek, *Wadnaminga* Springs. As to the actual manner in which the form in *ngga* appears in prepositional words we have such illustrations as these: *Mikangga* means *before*, literally *in the eye of*; *Ngurrungga* means *behind*, literally *in the back of*; *Marrangga*, *alongside*, literally *at the hand of*; *Tangkanugga*, *inside*, literally *in the liver of*. Still further, we are familiar with the forms in *war* referring to rivers and waters. Now, this very form has also found its way into the list of prepositions used to indicate that the idea of *rest* is signified. Here then are three distinct roots all agreeing in being root forms for water, and all agreeing in having been used for the grammatical convenience of supplying prepositions to signify rest. As to the forms in Western Australia so frequently taking shape in names ending in *up*, it remains to be pointed out that the equivalent comes to the surface in New South Wales. This is in the particle *ba*, which indicates locality. Thus *Mulubin* is the name of a species of fern which grew where Newcastle now stands. By the addition of *ba* to *Mulubin* there was formed *Mulubinba*, the native name adopted to designate Newcastle, and meaning the place where the fern called *mulubin* grows.

Following the course pursued all through this paper, it remains only to point out that something very similar to the foregoing has been developed in the history of other languages. A good

example is easily found in the Shemitic languages. In the case now contemplated it is the important word for *house* that undergoes transformation till it is converted into a preposition. In the Hebrew we read of the ark being pitched *within* and without. Here the expression translated *within* is in point of form "*from the house.*" In the Syriac, one of the Shemitic languages, where we say *in* the tomb, the idiom of the tongue just named takes the form "*in the house of* the tomb." And still farther, where we would speak of a man appointing a festival to be held *on* his birthday, the Syriac idiom a limits of the expression in point of form "*in the house of* his birthday." The stage naturally followed of abbreviating the word for *house*, and using it systematically as one of the fixed prepositions in the Shemitic languages. Its use was so extensive that the rabbis divided it in a threefold manner, namely, into the classes of cases in which the meaning was set forth by *in*, by *at*, and by *with* respectively.

On the subject of the euphonious names given by the aborigines to rivers and waters, a very few sentences must suffice. The softly flowing syllables which go to make up many of these names have often been the occasion of remark. Upon the most cursory examination it is found that many of these names are characterized by a predominance of what are called the liquid letters, namely, *l*, *m*, *n*, *r*. Hence the melodious smoothness of such names as *Araneip*, *Maranoa*, *Arafura*, as applied to streams. Indeed, names can be picked out of the gazetteers containing the whole four liquids with no other consonant. Thus *Mullinarran* Creek and *Nammerella* Creek. But the moment we come to figures, as between the liquids and soft labial on the one side against the dentals and gutturals on the other side, the result is very marked. Take the forms in *mur* or *bur* and *nut*, or their equivalents. *Mur* occurs in about sixty names of creeks or waters, *Bur* in about eighty, and *nut* in only about a dozen—that is, in the Gazetteer of New South Wales. The choice between the softer and harder forms of letters of the same class has some quite remarkable exemplifications. Thus, taking the three leading channels for names to designate rivers or waters, namely, in *mb*, *ng*, and *nd*, as against the harder forms in *mp*, *nk*, and *nt*, and the result is very decided. In the former case, the forms are embodied in upwards of 170 names of streams or waters in New South Wales, while hardly half a-dozen examples are found of the latter In the longer forms, *mbl*, *mbn*, *mbr*, *ngl*, *ngn*, *ngr*, *ndl*, *ndn*, *ndr*, as against, *mpl*, *mpn*, *mpr*, *nkl*, *nkn*, *nkr*, *ntl*, *ntn*, *ntr*, the result is equally decided. The former class are exemplified in upwards of 110 cases, while the latter are exemplified in one or two cases. Here a few possible oversights in searching through a large volume would make no substantial alteration in the relative places occupied by the classes of names compared. Still further,

take nine forms, such as *ml*, *mn*, *mr*, *bl*, *bn*, *br*, *wl*, *wn*, *wr*—where we have the liquids and soft labial—and compare them with any such forms as *wg*, *wk*, *wd*, *wt*, *pg*, *pk*, *pd*, *pt*—where these are mostly gutturals and dentals—and the result is quite decisive. The former list enters into the names of nearly 400 creeks, streams, and waters, while the latter list barely musters twenty. Of course, exhaustive detail would bring out some peculiar points; but there is no mistaking the general drift and direction of the figures adduced, taking the Gazetteer of New South Wales as supplying the area of observation. Out of about 4,700 names of all sorts, about 3,000 are aboriginal. Of these, again, nearly 800 are names applied to rivers, creeks, and streams generally, as well as to water in its other forms.

Summing up, and carefully avoiding sweeping generalizations from one corner of a subject, it may at least be concluded that in the matter of fixing or adopting root-words for water, the aborigines, or rather their forefathers, take rank broadly with the rest of the world. But even this simple conclusion has its decided bearing on some questions which have been raised:—Thus, (1) let it be supposed for a moment that the aborigines of Australia are a special centre of creation, and have existed, say, 100,000 years on this continental area; in that case, the substantial amount of identity displayed between them and other races in the world, in the matter of adopting names for water, cannot escape notice. Plainly, if this identity should be found to extend over a wide area of comparison, then, so far, the supposed necessity of resorting to the theory of special centres of creation for the human race must disappear. Then, (2) there is the observation as to the amount of change which might take place in languages such as the Australian, which are exposed to the operation of certain capricious influences. Thus, upon the death of a chief named "River," the word *river* would suddenly drop out of use. Now, in the course of centuries, to say nothing of decades of millennia, the changes so produced in the vocabulary of a language would be very considerable. But, in full view of all such considerations, it is pretty plain that if the forefathers of the aborigines of Australia broke off from a parent stock only 2,000, or 3,000, or 4,000 years ago, their descendants have faithfully retained the use of the primeval root-words for waters and streams, and have given them a permanent existence in the numerous names which have been adopted from the black man by his white successor.

Discussion.

Rev. R. Collie, F.L.S., intimated that on looking over the paper he found that the name Alambar was included by Mr. MacPherson amongst aboriginal names, whereas it was an Indian word, having been the designation of a gentleman's residence in India, who, having finally settled in this Colony near Glen Innes, called the name of his station Alambar.

I have looked over carefully the above paper, and examined it with the native names for water in Victoria, South Australia, and the Malay Archipelago. The study of Hebrew and the cognate languages evidently gave the impulse to Mr. MacPherson to take up this subject. Starting with the root-letters in the Hebrew word for water, he tries to discover how many native names have the letters m or mb, mp, applied to water in rivers, creeks, lakes, lagoons, &c. Not only so, but the ancient languages of the world are also consulted. Thus, the Phœnician "mu" for water, and the Egyptian, "me," are taken into account.

Reference is made to the names of streams in Australia in "cmb," "gmb," "kmb," such as Wamba Ponds and Wallomba Brook. Similar words, says the author, are found in the languages of the Malay Archipelago. In looking over 59 words, furnished by Wallace, representing as many languages for the word water, I find that there are only two which have the slightest resemblance to the above specimens, "manu" and "banyu." Again, it ought to be remembered that the various languages of the natives of Australia have nothing in common with any language outside the continent, and indeed have very little resemblance to one another. The natives of one side of a creek have a different language from those on the other side. Hence the difficulty to do any good to them by missionary enterprise, &c. Such being the case, the forms of words which seem to have a common origin are generally accidental, and must not be pressed too much to support any theory. I fully expected to have found more words in the languages of the Malay Archipelago for water with "m-m" or "m-u" than I did, as it is generally agreed that the aborigines came from the north, and must have lingered for some time among the islands of the Archipelago. I have examined several vocabularies of the native tribes in South Australia, and have found nothing to lead me to suppose that the letters "m," or "mb," or "mp," had anything to do with water. I have also examined the vocabularies of the native tribes of Victoria, as furnished by Smythe, with the same result.

The method of consulting the various gazetteers in New South Wales for the meaning of native names is not to be commended. Names have been introduced which are Indian, &c., and are found in the gazetteer as native, and in one instance at least the writer

of this paper has fallen into the trap. "Farrucabad," near Glen Innes, has been regarded by many as a native name, but it comes from India, as the owner of the station resided in India for many years.

The so-called native names are sometimes only a modified form of English words, and the greatest care has to be taken when reference is made to gazetteers, as was often done by the writer of this paper.

Sir ALFRED ROBERTS suggested that the paper be subject to revision before being printed with the Society's transactions.

Mr. J. F. MANN pointed out that many instances had occurred of attempts on the part of blackfellows to pronounce European names being recorded as aboriginal words. The names Gabo and Woolloomooloo were aboriginal corruptions of the words Cape Howe and windmill. The natives appeared to name rivers from the different kinds of trees and shrubs growing on their banks. This was the case with the prefix "yarra," which is of frequent occurrence, and indicates a particular sort of gum-tree. Sometimes, as in the case of the Murrumbidgee, a river was known by over 50 names throughout its whole course, and aboriginals appeared to know every bend by some particular name.

Mr. JOHN F. MANN writes as follows :—I have read with much attention the accompanying paper bearing the above title. The object of Mr. Macpherson is to discover whether, in giving names to a river, or water of any description, the aborigines were guided by certain laws, and adopted the principles which are found to prevail in the languages of the world. The language of these aborigines is extremely expressive, every name almost is a compound word, each syllable of which has a signification ; so that the name of a place at once expresses and describes the particular locality. Before commencing to analyse any of these names, it is well to make certain that the word is a genuine one ; failing in this, Mr. MacPherson has unconsciously fallen into one or two slight errors. (See "alumbah," page 3, and "Oakey Creek," page 11.) It is much to be regretted that in the early days of settlement so little attention was paid to the nomenclature, or that when a name was obtained greater care was not practised in the orthography. Taking this carelessness into consideration with the distortion which all the native names have been subjected to, it is a matter of difficulty now to obtain a reliable word. "Any way will do to spell a native name," I have heard said on more than one occasion. One of our most reliable and accomplished surveyors confused the name "Cape Howe" so as to represent a name "Gabo," and when such euphonious names as "Eurobodella," "Taralga," "Larella," and others are converted into "Boat Alley," "Trialgang," "Larry's Lake," &c., it behoves a philologist to proceed with

caution; for so common have these misnomers become that many of the younger generation of blacks have adopted the altered word.

Mr. MacPherson assumes that each compound name includes one or more syllables which indicate a root-word used by the aboriginals to refer to water, and then in many cases identifies this word with one having a similar signification as used in other parts of the world, and gives innumerable examples in support of his argument. However ingenious this theory may be, I think that it will prove a difficult one to carry out, for one will find that in following up the arguments you suddenly come upon a similar name attached to a hill or land of some sort. Take the letter *m*, for instance. This being the first example selected by Mr. MacPherson, it applies well to the name of the river Murrumbidgee, as representing the humming sound of water as it flows over stones, &c. But following the argument up, and the river down, as it increases in importance, and gathers more roots, you come upon a hill in the neighbourhood of Yass, and about 15 or 20 miles from the *Murrum*bidgee, named *Murrum*bateman; and so you may follow on until the peculiar humming sound of *m* culminates in a range of mountains, near Molong, known as the "*Mumbles*."

Again, take the Wollondilly River as an example. It is true that the Wollondilly is joined by the Mulwarree Ponds at Goulburn, but the "murmur of the waters" can be only heard in the Wollondilly branch, which throughout the whole length flows through a hilly and mountainous country; whereas the Mulwarree is but a long chain of ponds rising in a swamp, and flowing only in time of flood through marshy land. To follow the reverend author through the long list of references which he gives in support of his theory is more than I dare attempt, even supposing that I felt myself competent to do so.

Mr. MacPherson gives (page 17) the word *bidge* as meaning water. Mr. de la Poer Wall, in his "Manual of Physical Geography of Australia," page 77, describes the name Murrumbidgee as meaning "beautiful river." In connexion with this I may refer to the name Kurkerducbidgee. This is the native name of a small plain or flat on the Shoalhaven River, about 12 miles on the Goulburn side of Braidwood. According to my informant, an aboriginal, kur means a mouth; kur-kur, a long mouth or beak; and kur-kur-duc, the bird known by us as the "native companion." This plain was, and probably is now, the resort of this bird, a large crane, hence the word kur-ker-ducbid-gee. Kurkur also means "mouth" in the Lake Macquarie and Newcastle dialects. I am under the impression that the termination *bid-gee* means a flat by the river side; and this explanation will agree with a description of the Murrumbidgee River; but which syllable refers to water I do not undertake to say.

The name Currockbilly or Kurwikbilly is given to a high mountain in the coast range near Braidwood. Two long valleys in this mountain are known as the great and little *Kurradur*, on account of the resort of this bird. The same name may be found for a place near Mittagong, which possibly this bird at one time frequented. I mention this case also to show that in naming places the aborigines were guided by circumstances, adapting the name to natural features, the growth of certain trees or flowers, the feeding place of animals, birds, etc.

"Billy-bong" literally means a blind creek, *bong* means dead, the water flowing over low level land, and occasionally vanishing amongst the grass; consequently, *billy* refers to the water. Repeating a word indicates extent, great, large, etc. Thus Bong Bong applies correctly to that part of the Wingeecarribbee River which flows past Throsby Park, the land being so level there as to make it a matter of difficulty to trace the course of the river. On the Bredalbane Plains we find the name of Mut-mut-billy and Mill-bang or bong. *Mill* means to see; Mill-bong means blind or dead eye. I do not know what *mut-mut* alludes to, but these names evidently refer to the spread of water over this large extent of flat land, and to its being invisible on account of grass, etc., at times. The terminal *dilly* also, no doubt, refers to water, but I can give no interpretation of *Wollon*.

I endeavoured to reconcile the termination *gong* with a word meaning a swamp. Mittagong proper is the range separating Wingeecarribbee Swamp from the Nepean River. The site of the railway-station is quite out of position. It was across this range that the first settlers penetrated into what was for many years afterwards known as the new country, now better known as Bowral, Bong Bong, Sutton Forest, etc., and was for a length of time called the Argyle Road. This large swamp lies at the base of this range; *Tom Thumb* Lagoon adjoins Woollongong; then there is the *Terragong* Swamp at Kiama, and the extensive swamps at the head of the *Cudgegong* River. But this leaves *Gulgong*, *Gerriegong*, and many other places without a swamp, so that this arrangement becomes futile, and the same result occurs in many other similar cases.

At page 11 Mr. MacPherson assumes rather decidedly that the name Oakey as applied to a river or creek simply means *water*. I cannot agree with this assertion. The word "oakey" simply refers to the native oaks, or casuarina tree which fringe the banks of a stream; the name occurs in numerous instances throughout the country, and is used in a similar manner as sandy, stony, wattle, and other such things to denote a particular stream. (This tree is in no way allied to Quercus).

It must be borne in mind that the author writes tentatively only. As he states, he puts forth his suggestions by way of experi-

ments; but he—the result of longand patient research—gives such a vast amount of information, so many examples of words used in all parts of the world to mean water, that the paper must be considered as an extremely valuable one, as it paves the way for anyone who chooses to follow up this interesting subject. I have only ventured upon making a few remarks; but in the hands of a philologist it is a matter which could be extended considerably. The way to proceed would be to obtain the services of intelligent natives, who might be able to interpret many of these compound names: though I am aware that many of these men know nothing of the origin of these names. How few Liverpool men know the origin of that name! which, like *Kumidgebidge*, is attributed to a similar bird feeding on the adjoining swamps. If a true interpretation cannot be obtained, some clue might be discovered as to the principle adopted in the formation.

The word *naoi* (see page 10) canoe, is also given to Orion's belt by the aborigines. The three stars are supposed to be three rowers who are on their way to the pleiades in search of wives.

The late Sir Thomas Mitchell was a most reliable author; being a good linguist, and possessing a good ear for sound, he noted every syllable correctly. He preserved the native name of Darling Point, where he resided for many years, the name being Yarranabee, the meaning of which I do not know. The site now occupied by the garden of Mr. Jas. S. Mitchell was formerly a large lagoon surrounded by high reeds or rushes. The word Yarra appears in several places about the Murrumbidgee near Yass, or Yarrh, but I cannot attach a swamp or lagoon to any of these spots.

In riding to Sydney from his residence—which he did daily, Sir Thomas suffered much annoyance when passing Rushcutter Bay, by numerous small dogs rushing out from a hut and barking at him, he named the place "Barking Glen", hence *Barcom Glen* has become a permanent name.

Mr. E. DU FAUR remarked that the original plans of the Murrumbidgee River showed names for every part of it, and that some of the words were of eight syllables, and unpronounceable by Europeans.

Mr. TREVOR JONES said that S does not occur in native names, and that the aboriginals cannot pronounce the letter F, but both these letters are often found printed on maps and plans in native words.

Our Lakes and their Uses.

By Fredk. B. Gipps, C.E.

[*Read before the Royal Society of N. S. W., 1 September, 1886.*]

The influence of lakes in all parts of the globe on the river systems in which they are included or with which they are nearly connected, and through their channels, on the wealth and commerce of different nations, can only be justly appreciated by an intimate knowledge of their physical features and geographical position, but their value in stimulating commerce and different industries is of such world wide recognized importance, that the investigation of the lake system of this Colony should commend itself to more than ordinary interest. But for the Nyanza lakes, more than 3,000 miles distant from its mouth, the Nile would resemble many of our inland rivers that lose themselves in large swamps, or are represented in dry seasons by chains of waterholes, and the granaries of Egypt, for so many centuries celebrated throughout the world, would have been unknown. But for those huge reservoirs, instead of the mighty cities which covered its valley with a dense population, which were the centres of the arts and sciences, the very cradles indeed of civilization, there would have been for all ages a silent desolate wilderness, as dreaded by the traveller as the Great Arabian Desert. The unclouded sun would have blazed day after day on arid sands on a treeless waste, over which the scorching winds would have blown as a furnace blast. Human life in that dreary domain would have been insupportable; but it was otherwise ordained. Chiefly through the instrumentality of the Nyanza lakes, the valley of the Nile was ordained from remote ages and through countless generations to hold pre-eminence for its great fertility. Year after year heavy tropical storms, and at certain seasons continuous rains pour torrents of water into these lakes and increase their depth. This increment is gradually distributed through the channel of the White Nile, keeping up a constant stream, whilst its tributaries, the Atbara and Blue Nile from the Abyssinian highlands, so swell its volume with their muddy streams when in flood, that it gradually covers the lower valley. Thus in this rainless region the seed is germinated and nourishment is given to the crops, whilst the yearly deposit of silt accounts for the undiminished fertility of the soil. Just as the Nyanza lakes serve as the cisterns of the Nile, so the Italian lakes act as balance reservoirs for the Ticino, Adda, Oglio,

and Mincio rivers. But for the lakes which receive and discharge them, these rivers would at times thunder down through the rocky gorges of the snow-capped Alps, and with their resistless torrents, sweeping away all human efforts to control them, would flood and devastate the whole intervening country to the borders of the Adriatic Sea, whilst at other seasons their streams would be so shallow and contracted that navigation and irrigation would be impracticable. Instead of contributing to the fertility of the rich plains of Lombardy, instead of promoting and sustaining the commerce and principal industries of a dense population, these rivers, but for the lakes which control them, would be sources of dread and desolation. Having briefly touched on the important functions of lakes in different parts of the world, I will now proceed with a description of a few important lakes in this country, followed by certain suggestions for the application of their waters to the advantage of the State. As an appendix to this paper, I have prepared a summary of descriptive data of the principal lakes of the Colony, as far as the limited reliable information at command permitted. On examining this, it will at once be obvious, that nature who has dealt so bountifully in other countries in her provisions for the storage and gradual distribution of large sheets of water has been singularly niggardly respecting this country, for even our largest lakes have been known to dry up completely after protracted droughts. As if, however, to compensate somewhat for such neglect, she has, in the features of the upper part of our valleys provided sites for the formation of large artificial lakes well adapted for the impounding of deep and capacious sheets of water. For instance, just below the junction of the Indi and Hume rivers, which forms the head of the Murray, a dam, 80 feet high, thrown across the valley, would impound a reservoir equal to some of the Italian lakes in area. Such a lake would receive all the snow and storm waters of a mountain water-shed of about 1,100 square miles, and acting as a balance reservoir, would discharge a continuous stream throughout the year, providing if necessary, for permanent navigation between that point and Albury. It would also, acting as a compensating reservoir, permit of important tributaries, which join the Murray lower down, being diverted by New South Wales and Victoria for irrigation and industrial purposes. Thus the sources of the Tooma River could be diverted by a canal into the Tumut, and thence into the Murrumbidgee River. The length of such canal, I have proved by a contour survey, would be only 11½ miles, and its cost, including head works, I estimate at £12,000. Its course would command large deposits of auriferous gravel, which would probably prove of some value to the State, whilst the increment of water to the Murrumbidgee would be considerable and continuous. In fact almost all our river basins offer somewhat similar advantages for the construction of artificial lakes, but their further

consideration is beyond the scope of this paper. A further study of the descriptive data of our lakes demonstrates, that lake George, from its position, elevation, and dimensions, offers superior advantages over all others, for the useful application of its waters. This lake is situated at the summit of the Main Dividing Range, traversing the Colony from north to south, and is 2,230 feet above sea level. It has no outlet, but is surrounded by a water shed which includes a basin of about 490 square miles, and which is formed by the bifurcation of the main range, a few miles south of Bungendore, the left arm of which continues almost a straight, unbroken, northerly course, whilst the right arm straggles round a long north-easterly course, and then swerves to the north-west till it unites again with the left arm on the northern boundary of the basin. Over one half of this basin is covered with plains, swamps, and the bed of the lake. The range forming the left arm rises abruptly from the borders of the lake, at times forming prominent peaks, at times sinking to low saddles, one of which known as Geary's Gap, is only 80 feet above the water level. From the abruptness of its spurs, it gives the impression that their lower extremities have been buried in their own detritus, by the wasting action of ages of atmospheric exposure. The shore at the foot of the range slopes very gradually towards the centre of the lake, and the water is consequently shallow for some distance out. The rocks chiefly met with are hard metamorphic schists, having a northerly strike and steep westerly dip, but the most noticeable are a coarse grained gneiss, and a very hard breccia or conglomerate composed of quartz pebbles, cemented together by silica. Belts of these rocks run out for some distance into the lake forming the most prominent points, whilst for miles the shore is covered with their remains. The formation of the low gravel ridges on the north and south of the lake is probably due to these conglomerate belts which have wasted into beds of creeks, the flanks of which, composed of softer micacious schists, have been gradually washed into the bed of the lake, leaving the ridges behind. The quartz pebbles are angular, and bear no sign of having travelled any distance, or having been washed and thrown up by the waves of the lake. The Breadalbane plains form the principal portion of the north end of the water-shed. The three plains are 10 miles across, and near their upper end are only separated from one another by a low spur; but this spur rises considerably going south, and finally terminates in a long narrow neck, on which a portion of Collector is built. The Muthilly Creek flows along the western flank of the third plain, and 35 feet above its deepest depression, which is 2,254 feet above sea level, and appears, as will be seen by the accompanying section, to be gradually forcing its course towards the valley of the Fish River, from which it is now only separated by a ridge 100 feet higher than its bed. Supposing this barrier removed, it would rush

down the steep fall into the Fish River, and quickly expose the bed of the Breadalbane plains, and of lake George beyond them. The same section shows, that the Wollogorang Creek is apparently wearing its course up the ridge which separates it from the Wollondilly River, and which is barely 100 feet higher than its bed. It may therefore be inferred that, in course of time, these creeks, instead of flowing into Lake George, will find their way into rivers flowing in contrary directions, leaving deep gravel drifts as the only remnant of the lake. The eastern portion of the water-shed is much more broken than the opposite side, owing to the numerous low spurs thrown out from the main range, which divide different creeks discharging into the lake. Towards the centre and southern end, these spurs have been almost denuded of timber, and consequently every heavy storm washes a large quantity of silt into the lake. On the south the water-shed is bounded by the high dividing range of the Molonglo River. The principal supply to the lake is derived from the following creeks —Mutbilly and Wollogorang on the north; Kenny, Taylor, and Batmaroo on the east; and Turallo Creek on the south. The Mutbilly and Wallogorang Creeks rise in the ranges about 15 miles above Collector, and flow into the lake at the present time, about 6 miles below it. They each flow through two or three large waterholes, one of which on the Mutbilly Creek, was 20 feet deep at the close of the last drought. But a minimum portion of the rainfall on the basins of these creeks, seems to find its way into their shallow channels, owing chiefly to the porous character of the plains they intersect. During a recent visit. I found the Breadalbane plains covered with water after an incessant rainfall of nearly 3 inches, and yet a rough measurement on the foot-bridge across the Mutbilly Creek just beyond Collector, gave a discharge of only 8 million gallons per diem. Kenny's and Taylor's Creeks, rising in the bounding range from 5 to 6 miles east of the lake, though insignificant streams, are the chief conveyors of silt to the lake, and are fast filling it up on that shore. Butmaroo Creek rises in the mountain chain 16 miles south-east of the lake. Though generally a small stream, which is just to be seen running over its sandy bed after heavy storms, it throws a large volume of water into the lake. Turallo Creek on the south, flows about 16 miles, and in its characteristics is somewhat similar to the Mutbilly Creek, as it traverses a long plain which soaks up most of its mountain supply, previous to discharging into the lake. Lake George at the present time is a fine sheet of water, from 14 to 15 miles long, with an average width of 3·8 miles, and average depth of about 8 feet. It has a very shallow shore on the north and south, and for about $\frac{1}{4}$ mile out from its western rim, and is generally deepest on the eastern shore. Its maximum length is 21 miles; its maximum breadth, from the mouth of Kenny's Creek to Geary's Gap, is 7 miles; and its maximum depth is said to be

25 feet. Mr. Russell, the Government Astronomer, in his notes on the climate of New South Wales, describes it as the largest and most important of the fresh water lakes of the Colony, fed by a number of creeks from a watershed of about 1,200 square miles; he asserts that its water was brackish, but drinkable, except in dry seasons, and he estimates the evaporation as equal to 2 feet in wet seasons, and from 7 to 8 feet in dry seasons. In his Presidential Address before this Society last year, however, he modifies his previous views considerably, both as regards the freshness of the water, and the effects of evaporation, and takes exception to the proposals to use the lake as a reservoir for the supply of towns. He then regarded the water as unfit for use, on account of its purgative properties, and added that it was reported that the drainage from the Currowang Copper Mine had poisoned all the fish. This mine is situated near the north-eastern shore of the lake, and the drainage from its underground workings into the pump well was so impregnated with copper, that it completely coated a sheet of iron and some tools which had been left in it for a time. The baling of this water into a creek connected with the lake, must have contaminated the water in the immediate vicinity, but is certainly not a sufficient cause to account for the death of fish miles away from the locality. In any case if this mine is ever worked again, a repetition of the mischief can easily be prevented, by distributing the well water over the adjacent hills. As regards the brackishness of the water, it must be patent to anyone who studies the condition of the lake, that, owing to its shallow depth round three sides, that induces great evaporation, owing, also, to its confinement and to the character of some of the rocky ridges enclosing it, certain salts would aggregate, making the water unpalatable, and perhaps after exceeding long seasons of drought, injurious, but change those conditions, and I maintain you could ensure pure, palatable water at all seasons. By throwing the flood waters of another river into the lake, and by constantly drawing it off in large volumes, the noxious salts would quickly be dispersed. All the streams supplying the lake are fresh, and most of the large deep waterholes and gravel drifts in the plains above and below it, supply excellent drinking water. Even when the lake itself is fast drying up, sheep and cattle drink and thrive on its water, whilst as it recedes, it leaves a nourishing pasturage of wild parsnip, and large succulent cane grass, which stock of all kind devour with avidity. This proves that its water possesses valuable properties favourable for the nourishment of vegetation, and therefore admirably fitted for irrigation. In his address, Mr. Russell doubts whether any large quantity of water could be withdrawn, because "during 64 years for by far the greater number of years, the supply of rain water has not been equal to the evaporation." On reflecting on all the conditions connected with the fall of water in the lake, I am led

to distrust the theory that evaporation is the sole cause of it, and to favour rather the presumption that it is phenomenal, thus resembling the remarkable lake of Zirknitz, in the mountain fastnesses of Illyria, which disappears and refills according to seasons, owing to its bed being connected with subterranean vents in limestone, which fissures readily. Hence it happens that its basin is at different times the scene of fishing, hunting, and harvesting. The accompanying longitudinal section of Lake George and plains adjoining it, shows that there is a gradual dip from both extremities towards the centre, and that the whole length of the bed of drift from north to south is nearly 40 miles, whilst its average width is estimated at about 6 miles. This gives approximately 240 square miles of drift, of which 60 square miles are covered with water when the lake is 15 miles long, leaving 180 square miles beyond the influence of evaporation, through which the water is slowly percolating, thus by its supply, diminishing the quantity which the waste of evaporation would otherwise record on the gauge. By Mr. Russell's rain and river observations of 1885, it appears that the lake lost 1 inch in depth by evaporation in three days, from September 5th to 7th ; but this actually represents a far greater loss, because the whole area of 240 square miles had been drawn on, and lowered. Such excessive evaporation at that season induces the presumption, that there was some other cause for the fall in the lake. The actual effect of rainfall on the supply of the lake is also doubtful. On April 15th, 1885, it appears that, though 1½ inch of rain fell, yet the lake only rose 1½ inch, showing how small a quantity from the whole basin found its way directly into the lake ; whereas, according to observations in 1875, though the rainfall for the whole year was only 25 inches, yet the lake rose 5 feet 3 inches between April and October. Assuming that the rainfall for that six months was 18 inches, and that the loss by evaporation was only 1 foot 3 inches, then, according to the above rise, about 70 per cent of the rainfall found its way into the lake. For such rainfall, over 490 square miles represented a supply of 20,490,000,000 cubic feet of water, whilst 6 feet 6 inches rise in the lake (including 1 foot 3 inches loss by evaporation) was equal to 14,587,373,000 cubic feet of water. But between 1831 and 1850, the lake dried up continually, whilst between 1850 and 1869, it fluctuated considerably, though during those 38 years, the rainfall was often heavier than that of 1875. Here, therefore, is additional evidence that some underground agency is at work, supplying and draining the lake, and that in some years this agency is more powerful than in others. Extended observation may discover that fissures and springs in the limestone belt, and trap rock that traverse a portion of the basin, may be accountable for the fall and rise of the lake. This is simply an hypothesis, unsupported at present by any direct evidence. Here lies this large expanse of water inert, impure, a

source rather of mischief than benefit to mankind, because of its fluctuations, what can be done with it? Some years ago, I maintained that there was a latent giant power in its water, that it contained elements of incalculable value to a vast multitude, if only an avenue was provided for its circulation, but the proposal has been adversely criticised and pronounced impracticable on account of the impurity of the water and its inconstant supply. As for the impurity of the water it could quickly be remedied by tapping the lake, and drawing off a large volume of water daily, whilst the intermittent supply is more imaginary than real, as, when the lake is completely dry, there is a great depth of water bearing drift, estimated to cover about 240 square miles to draw on. Supposing this bed of drift did not exist, would it not be more rational to use the available supply of the lake in irrigating the valleys beyond, than to allow its waters to waste away by evaporation and drainage. Two distinct advantages would thus be archieved, it would allow of the cultivation of a large portion of the present bed of the lake in security, and it would afford a large supply of water, for the profitable cultivation of an immense area beyond the lake. My proposal for the treatment of the impounded water of Lake George includes the following works :—

First, an outlet tunnel under Geary's Gap; second, a contour canal along the divide of the Murrumbidgee and Lachlan Rivers; and third, a supply canal from the Molonglo River to Lake George. The head of the tunnel would be located in the gravel drift, fully 20 feet below the level of the lake, it would pierce the Western Dividing Range at Geary's Gap in 1¼ mile, and would then end in Brooke's Creek, at the top of the Yass Valley. Its capacity would be 100 million gallons, and its approximate cost £50,000. The extreme height of Geary's Gap, above the level of the lake, is 92 feet, and its average height, above the roof of the tunnel, would be 60 feet. The rocks chiefly intersected would be metamorphic schists, intermixed with quartz veins, some of which, owing to the gold shed on each side of the divide, would probably prove remunerative. The contour canal from the outlet of the tunnel would traverse a broken country, which however, presents no serious obstacles to its excavation. It would almost immediately command a large area of auriferous drift, and the rich agricultural lands of the Yass Valley. Its length and capacity would largely depend on circumstances, which only a careful instrumental survey of the country can distinctly define, but by the attached sketch map it will be seen that, if sufficiently extended, it would command the towns of Gundaroo, Yass, Bowning, Binalong, Murrumburrah Young, Cootamundra, and Temora. It would offer facilities for irrigating 500,000 acres of rich agricultural land. With a supply of 10 million gallons a day to the following towns, Yass, Murrumburrah, and Cootamundra, owing to its great elevation above

them, it would provide 2,600 horse-power, valued at £15,600 per annum, which, estimating the gross power of a large mill at 86 horses, would establish no less than 30 factories, and would afterwards be available for irrigation, and water supply. By drawing off the lake continuously through the gravel drift, it would be perfectly clear, and very shortly sufficiently pure for the supply of towns. Presuming that the drift bed of the lake and adjoining swamps spreads over only 100 square miles, then, even after surface water had entirely disappeared, a supply of 50 million gallons a day could be ensured for many years without the assistance of rainfall. There is, therefore, no positive necessity for the supply canal from the Molonglo River, but owing to the large supply of absolutely pure water it would discharge into the lake, and also to the advantages it would offer to the country under its command, it would be highly desirable to construct it. The length of this canal would be about 42 miles, its fall 2 feet per mile, its capacity at least 50 million gallons a day. It would supply Queanbeyan with water for household purposes, and for machinery, and factories on a very extensive scale, and would irrigate a large tract of country on the right bank of the Murrumbidgee, below Queanbeyan; it would offer inducements for the development of the deep auriferous drifts at the head of Brooke's Creek; and lastly, by connecting wrought-iron pipes with a tank at its terminus, and using hydraulic nozzles, and elevators, it could be made to deepen the lake by raising and transporting thousands of cubic yards daily. It would discharge into Lake George at Geary's Gap. Thus briefly told is my view of the grand possibilities of this present useless, and positively injurious sheet of water; it can build up and sustain towns, it can cover the country for many miles with a contented, prosperous, and independent yeomanry, and lastly it can largely develop the hidden treasures of various goldfields. In another paper, I propose to continue my subject by descriptions of Lakes Bathurst, Cowal, Urana, and others in the interior, which may be expected to have a notable history in future ages, though, perhaps not quite as grand and interesting as that of Lake George.

Discussion.

Mr. J. F. Mann said: It is about 40 years ago since I first saw Lake George. It was then covered with cattle in thousands, and was a beautiful sight, and I had to cross it to get something to drink. The first heavy rains after that period filled the basin with water, and it has contained water ever since. I think that the cattle at that time must have, as it were, "puddled" the bottom. The principal loss of water is apparently by evaporation. If its waters were to rise but some 90 feet, they would submerge an enormous tract of country, and fall into the Mulwarree Ponds.

Fifty or sixty years ago, the land of a number of settlers was described as being bounded by the waters of Lake George ; and as the waters receded they followed, and thus enlarged their boundaries, and obtained about ten times as much land as was originally granted.

It is a curious thing where the fish come from ; I have seen the place completely dry, and after a while when it again contained water, excellent fishing could be obtained there ; and again the lake would be covered with ducks and black swans.

Mr. H. C. Russell said : I am very glad that Mr. Gipps has taken such trouble to put before us his views about Lake George. To me the lake has seemed a valuable index of the character of the climate, and one of the best means of determining the evaporation from a large quantity of water. About 1865–67 the Government Astronomer commenced to lay down the base line at Lake George for the triangulation of the Colony, and careful measures of the height of the water were then taken, but this unfortunately was not kept up. As far as I can ascertain, the lake was at its highest between 1870–71, when it was 12 feet higher than in 1885, but the measurement for the intervening years cannot be filled up exactly. Assuming that the evaporation was pretty regular, the lake has lost by evaporation all the rainfall and nearly 1 foot per annum besides, or about 40 inches in all per annum. It is rather curious that the lake has hardly been effected by the recent heavy rainfall all over the country. The average rainfall of the district is only about 30 inches. Mr. Mann has referred to what he calls the "puddling" of the lake bottom by cattle, and it is a most interesting suggestion, but a number of wells have been sunk in the dried part of the lake, and all of these were in gravel.

When the lake was first discovered, the blacks said that it was covered with a forest, and all the water went out through holes in the bottom. It was the only way they could account for the disappearance of the water ; but I think we cannot compare Lake George with Lake Tirknitz. That lake is upon a bed of limestone, and there are a number of deep holes in the bottom, through which it is supposed the water gets away. If there were such holes in Lake George at the bottom, one would expect the water to disappear gradually, but it appears that the water gets away very slowly indeed when the lake is full, and fast when it is low ; whereas, if there were holes in the bottom, the water would get away fastest when there was plenty.

Lake George does not seem to be affected, except on occasions of very great rainfall in its district ; and leakage cannot occur to any great extent through such hard rocks as form its bed.

Mr. T. Whitelegge said that he had examined some specimens of water from Lake George, and found in the sediment a number of fresh water organisms, and a number of diatoms—eight or nine

genera altogether—many being even then alive. There was something peculiar about the water, or these creatures would not have lived in it so long, and in ordinary water would have been destroyed by bacteria.

Dr. Thomas Dixson said, some time ago it was suggested as possible that the waters of Australia possessed medicinal properties, and Mr. Gipps has said that the waters of Lake George are purgative. A number of waters are used medicinally, but, up to the present time, there has been no systematic investigation as to whether the waters of this Colony have any such properties. At Cooma there are carbonated springs; at Berrima and Joadja Creek there are chalybeate springs, and possibly sulphur springs in other places; and near the Railway Station at Mittagong valuable medicinal chalybeate springs also exist.

Mr. C. S. Wilkinson, F.G.S., said, "that if Mr. Gipps's suggestions were carried out and the water purified, a large area of land could be made available, and the waters made use of in other localities. I examined the eastern side of the lake sometime ago, and in places round the margin there are high barriers of drift which run up into the valleys that drain the lake, showing that the lake at one time was a greater height. My impression was, after taking the levels round the margin of the lake, that it had at one time an outlet on the western side into the Lachlan. I think that there is an underground channel now buried.

The limestone masses in locality are not continuous, and in patches hardly extending more than $\frac{1}{2}$ a mile in length; these beds, as a rule, run north and south, and not east and west. I think it is quite impossible for the water to escape through them, but it must be through an old channel now filled with gravel. Sometimes there are large supplies of water in wells, and the channel having become blocked at times, by cutting a few feet, the workmen have come upon the old channel. I don't think that the limestone formation will account in any way for the leakage or drainage."

[Three diagrams.]

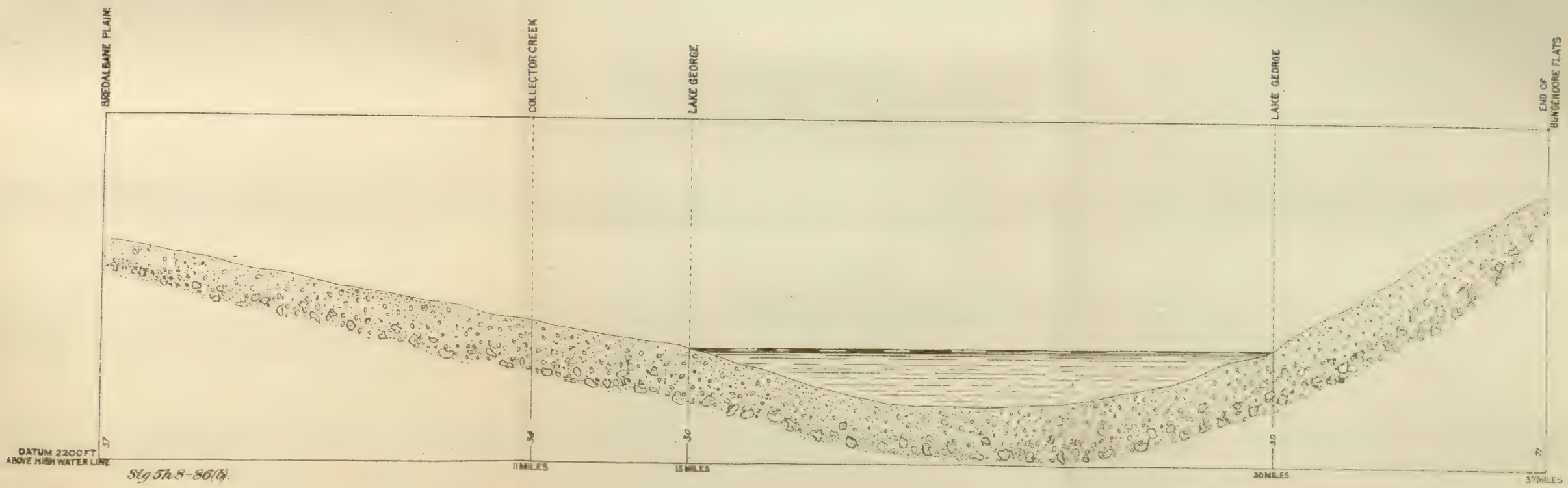
APPENDIX.

Descriptive data of Lakes in New South Wales.

Name of Lake.	Max. length in miles.	Max. breadth in miles.	Area in square miles.	Depth in feet.		Surface height in feet above sea level.	Area of watershed in square miles.	Sources of supply.	Outlet.	Remarks.
				Max.	Min.					
George	21	7	80	25	dry...	2,230	490	Mutbilly Creek ..	None.....	Rise and fall in this lake supposed to be partly attributable to springs and fissures in limestone and trap traversing a portion of its basin.
								Wollogorang ,,		
								Kenny ,,		
								Taylor ,,		
								Turallo ,,		
								Butmaroo ,,		
Bathurst.....	...	...	31¾	30	,, ...	2,000	100	.....	,,	
Urana	8	4	21⅛	10	,, ...	400	...	Urana.....	,,	
								Coonong.....	,,	
Cowal	16	10	50	15	,, ...	under 1,000	...	Bland	Cowal Ck.	
								Back	,,	
Carjellico ...	8	1½	10	15	,, ...	,, 1,000	...	Filled by floods in Lachlan River.	None	
Poopelloe ...	9	6	40	17	,, ...	250	...	Filled by floods in Darling River.	,,	
Victoria	10	6½	50	20	,, ...	100	...	Filled by Murray floods	,,	
Pitarpunga...	7	6	30	8	,, ...	under 500	...	Filled by Murrumbidgee floods.	,,	
Tandou	12	7	70	10	,, ...	,,	...	Filled by Darling floods	,,	
Menindee ...	9	9	56	12	,, ...	,,	...	,, ,,	,, ...	Circular
Cawndilla ...	8	6	42	6	,, ...	,,	...	,, ,,	,,	
Yantara	14	6	60	15	,, ...	,,	...	Whittabreena	.....	
								Whampa	.....	
Cobham	8	2	12	27	,, ..	,,	...	Evelyn Creek	.....	
Woytchugga	2·5	2·5	5	10	,, ...	,,	...	Filled by Darling floods	None	Round.
Gumgulka ...	8	3	15	10	,, ...	,,	...	,, ,,	,,	
Whampah ...	2½	·025	·60	26	,, ...	,,	...	Whampah	Whampah	
Narran	13	6	40	10	,, ...	,,	...	Narran River	None	
Boochatan ...	4	1·15	4	50	,, ...	,,	...	Filled by floods in Lachlan River.	,,	

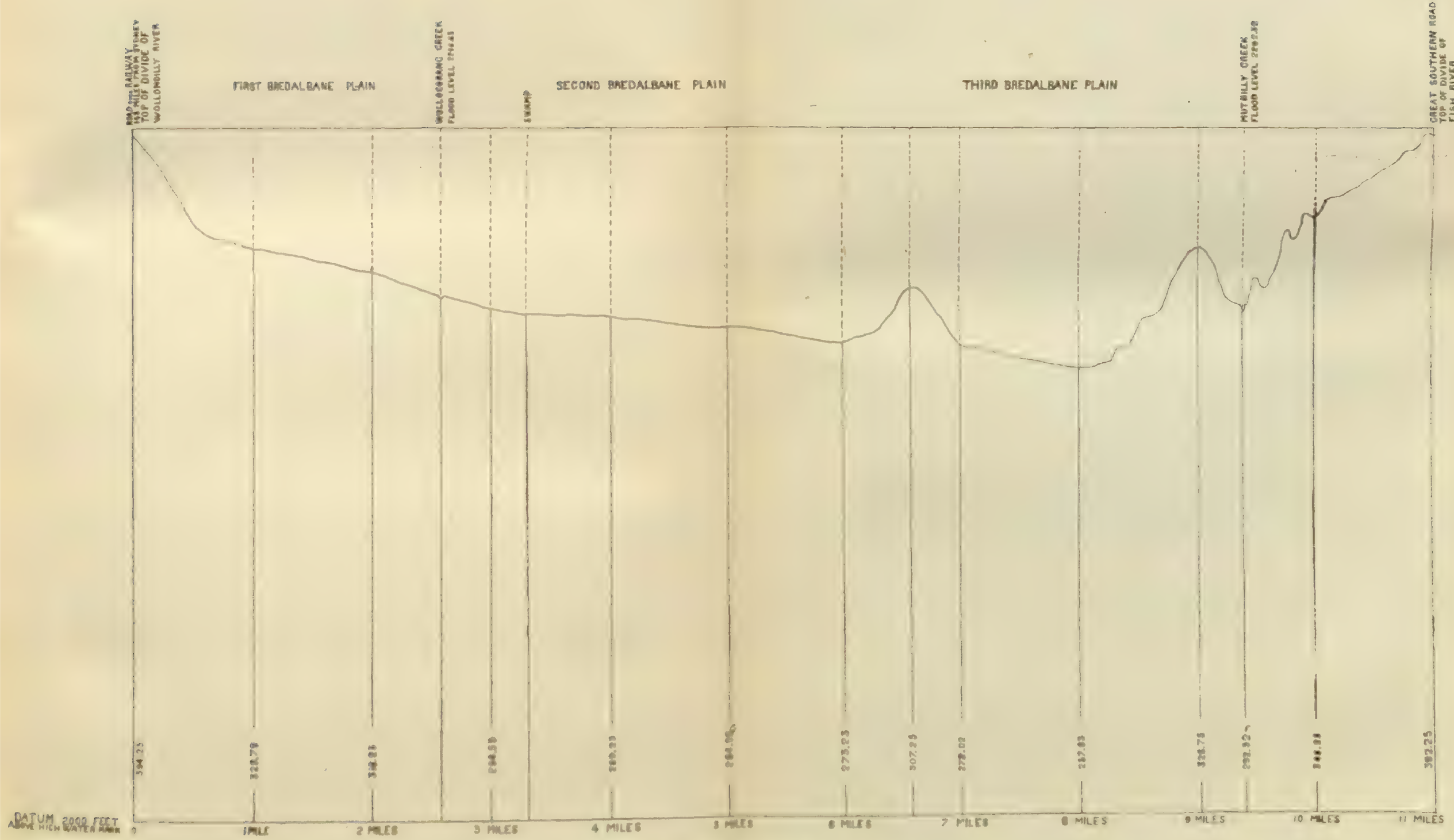
LONGITUDINAL SECTION
OF
LAKE GEORGE
AND
DRAINAGE PLAINS

PHOTO-LITHOGRAPHED AT THE GOVT. PRINTING OFFICE,
SYDNEY, NEW SOUTH WALES.



Sdg 5h 8-86(b).

CROSS SECTION
OF
TOP OF BREDALBANE PLAINS



5h8-86(c)

PHOTO-LITHOGRAPHED AT THE GOVT. PRINTING OFFICE,
SYDNEY, NEW SOUTH WALES

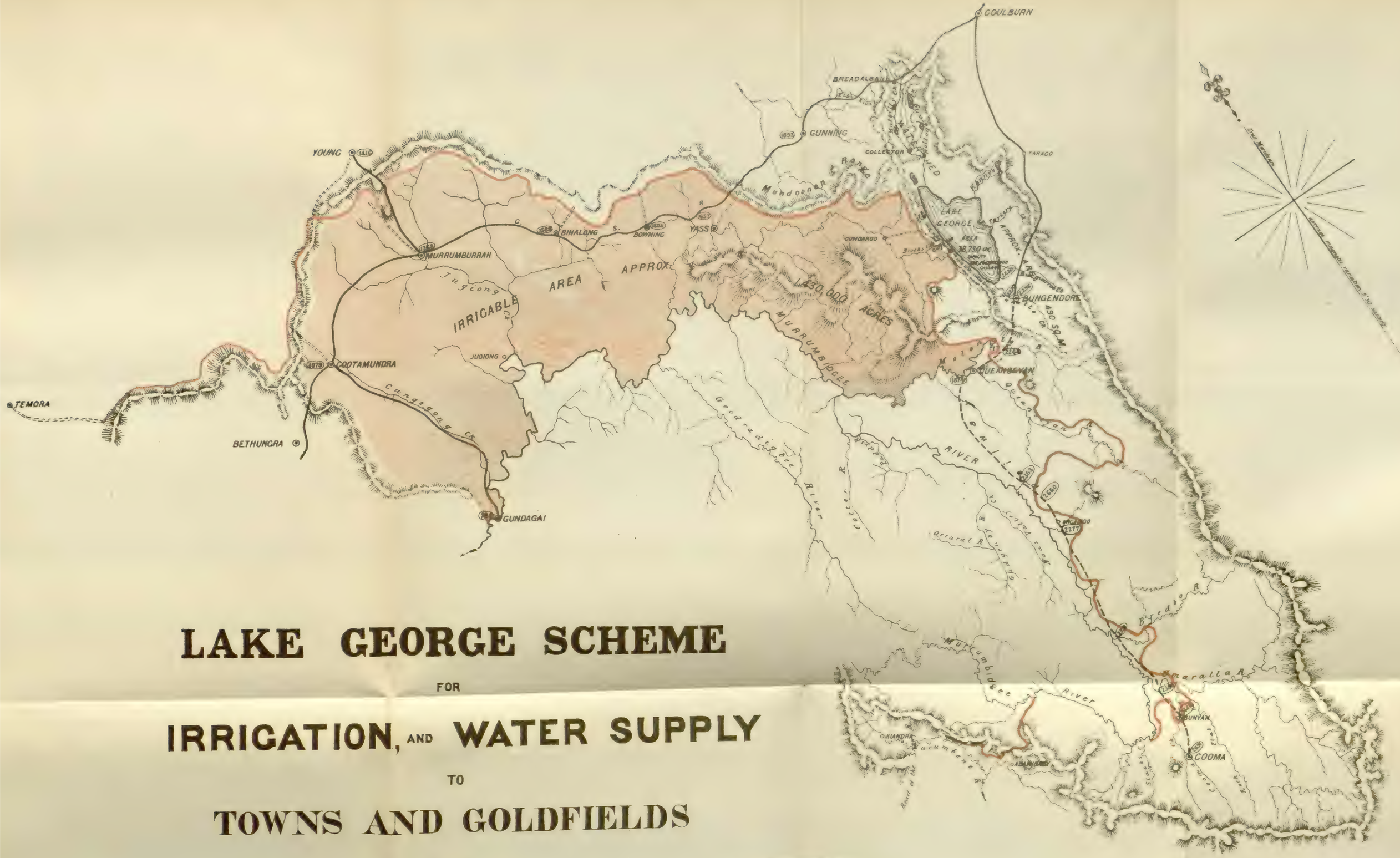
LAKE GEORGE SCHEME

FOR

IRRIGATION, AND WATER SUPPLY

TO

TOWNS AND GOLDFIELDS



PROPOSED LINE OF CANALS

" " " WROUGHT IRON PIPES

Scale

Miles 0 1 2 3 4 Miles

(Sig. 5th 8-86)d)

Fred^k W. Cotton. C.E.

Notes upon the History of Floods in the River Darling.

By H. C. Russell, B.A., F.R.S., &c.

[*Read before the Royal Society of N.S.W., 3 November, 1886.*]

For some time past I have been collecting notes about floods in the Darling, and although there are many persons who remember them for twenty, or even thirty, years, I have found great difficulty, in fact insuperable difficulty, in getting such an account of them as to height and continuance as we require. Nevertheless, the facts collected appeared to me to be of sufficient interest to submit them for your consideration. It is only another instance of the difficulty of arriving at historical facts twenty years after their occurrence. No record of the state of the river at Bourke seems to have been kept prior to 1871, when the Engineer-in-Chief for Harbours and Rivers established a gauge there; and for the few facts I have about floods in that river between 1835 and 1871 I am indebted to gentlemen whose names will appear later on. Mr. M'Intosh's history from 1861 to 1879 is a valuable contribution, and without it we should have no record for many of the years. But valuable as the records really are, I found it difficult to translate them into river measures so that I could put them into the diagram of the Darling floods. The heights of those of 1864, 1870, and 1879 are given with reference to known floods, but only these, and I trust my readers will remember this when consulting the diagram and subsequent pages.

For convenient reference it appeared best to put the substance of this history into a diagram which should show all the recorded floods. Those actually measured are shown in black, those recorded without measures by a shaded surface.

One serious difficulty affects all the records, and that is the question of "summer level," which is simply a point chosen for local convenience; generally it means that the zero used is four feet below that height of the water at which steamers can travel, that is four feet of water on the bars or shallowest places. But these points have not been, so far as I am aware, connected with the sea level until the gauges were put up at Bourke, Albury, and other places by Mr. McKinney, engineer for the Water Conservation Commission. From him I learn that the zero of the new gauge at Albury, 481·63 feet above the sea, and the zero of the

old gauge, is 8 feet above the zero of the new gauge. In the diagram summer level is the zero, and in all cases the records by the old gauges are used.

The diagram enables us to form some idea of the period for which the river is navigable each year, taking the past ten years, for which we have measures, and bearing in mind that when the water is 4 feet above summer level the river is navigable, it appears that during

1886	it was navigable	for.....	6	months
1885	do	do	3	,,
1884	do	do	2	,,
1883	do	do	7	,,
1882	do	do	4	,,
1881	do	do	3	,,
1880	do	do	9	,,
1879	do	do	10	,,
1878	do	do	8	,,
1877	do	do	4	,,
10 years.		Total	57	months.

but this is not a statement exactly in accordance with experience, for the river must remain navigable for a sufficient time to allow the steamers to travel the distance before navigation can be carried on. As an illustration of this I may mention that the "Eliza Jane," steamer, left Morgan, in South Australia, in May, 1883, and did not reach Bourke until June, 1886, although in the interval five short floods had passed down the river, in each of which she moved forward a little. These floods are shown in the diagram as five of the eight little floods in the interval. If, then, we leave out of consideration the little floods, there were forty months in ten years during which it was navigable, and during this period the river was practically not navigable for three years at a stretch, May, 1883, to June, 1886; but a reference to the diagram will show that during the previous ten years, 1867 to 1876, the conditions for navigation were much more favourable, and, I think I shall be able to show you presently that the probabilities are that during the next ten years the river will be in a better condition than during the past, although dry seasons must always play a conspicuous part in the history of the river Darling.

With reference to the diagram, I must explain that prior to 1870 it does not rest upon actual measures of the river heights, excepting in a few places; but that since that period it does. When first plotted this diagram was made so that the years followed each other in one line; but this was inconvenient, and it became necessary to arrange it in some way. So I tried three year periods, six years, and various others that have been suggested; but found that the only one which gave any indication of being the right one was nineteen years, and it is therefore arranged

so ; and it happens that we are in the last year but one of the cycle. You will see presently whether this is probably right or not. I am aware that very different views are held in reference to this period in our weather, and it is just one of these things in which people can well afford to differ, only it would not be a difficult matter to show that many whose names I could give have found the nineteen years period worth to them many thousands of pounds, and I am quite sure that if their intelligent use of the cycle had been at all general amongst our squatters, many ruinous losses would have been avoided.

The great majority want some definite, easily remembered rule as a weather guide, and they cannot have it, simply because the weather is not subject to such rules, and therefore they cannot be found out. But the one I marked out just ten years since in this room, and which I and many others have found of great value, is that, in a period of nineteen years, the general character of the weather returns. And, although this does not tell us exactly what to expect, it has proved to be quite enough for the purpose.

And I propose to show you that the river is no exception, as of course it should not be ; but that in these floods, a period of nineteen years is distinctly to be traced. Now, turning to the diagram, you will see that the great flood of 1886 has directly over it at an interval of nineteen years, the great flood of 1867 which was almost as great as that of 1870, and probably in 1848 there was a similar flood ; for although we have no river report for that year, still it was very wet at Sydney, and remarkably so on the coast to north of us. The drought of 1884–5 has directly over it that of 1865–6 and 1846 certainly, and probably 1847.

The floods of 1863 and 1864 seem to be exceptions, but we know little or nothing of 1844–5 ; there were sudden heavy floods in the beginning of 1882 and 1883, but they did not last ; but we do know that the sudden spring flood noted by Sturt in September. 1844, was reproduced in September, 1863, and in August, 1882. The drought of 1881 is found in 1862 and 1843. The flood of 1880 appeared in 1861, and probably 1842, for that was generally a wet year, although we have no report from the Darling. And the great flood of 1879 is found in 1860 and 1841. So also the good seasons of 1871–72–73 and 1874 follow in due course nineteen years after the good seasons of 1852–53–54 and 1855, but of the corresponding years 1833–34–35–36 we do not know very much. 1833 seems to have been rather a dry year, but it is said that more snow fell in one day of May. 1833, than during the whole winter of 1832. And 1834 began with a big flood in the Hunter River in February, very heavy floods in Sydney streets, and in Illawarra in April. In June, all the lowlands at Bathurst were under water, and in September there was a tremendous storm which left the snow 4 to 15 feet deep in Maneroo ; this storm began on July 25th, and

lasted with some intermission for three weeks ; 1835 seems to have been a dry year, and 1836 a wet one. In July, 1836, all tributaries of the Murray were in high flood ; at Bathurst in the beginning of July, snow lay a foot thick on the ground, and enough rain had fallen to last three months ; and the severity of this winter in the interior was unprecedented, and is said by Mr. Bonney to have been very wet on the western side of the range ; and the Murray tributaries were all in high flood in July, and I think there can be no doubt that in such seasons as 1834 and 1836 there were considerable floods in the Darling. The great rain storm on the Darling in January, 1885, had its exact prototype in January, 1866, long known as the great January rain, which made a rise in the river at Wilcannia of 18 feet, and that of 1885 did 28 feet. Unfortunately we cannot trace this great rain storm back through other years, but we know that both of them travelled across country from Wilcannia to the coast, passing over Lake George ; and it is very suggestive that the only record of January, 1847, along the whole storm-track was from a solitary observer with a rain-gauge at Naas Valley, not far from Lake George, and he says :—"January 5, 1847, was remarkable for the number of thunderstorms which passed over at 10 a.m. A smart shower began at 1 p.m.; another smart shower, with hail and thunder and lightning ; and all the afternoon to 9 p.m., we had a series of storms in which 1·40 in. rain fell," so that he certainly experienced a storm similar to those of January, 1866 and 1885, whether it passed over the Darling or not ; but there seems to be no reason to doubt that it did. 1870 again seems to stand alone. It is very much to be regretted that proper records of these rivers were not kept from the first ; we should now be, if they had, in a much better position than we are to discuss the navigation of the Darling, and the question necessarily connected with that—the periodicity of the seasons. I am quite sure that much more can be added to what I have said, for there are many who remember the river floods since the stations were first taken up there, and I hope they will give me any information they can that will help to illucidate this subject. I cannot close this paper without recording my obligations to those who have taken so much trouble to give me information, and whose names are mentioned in what has gone before.

Epitome of History.

1818.—Oxley, in June 1818, found the Macquarie Marshes so extensive that after going 30 miles in a boat he came to the conclusion that it was a shallow sea, and the water was from 3 to 5 feet deep, he tried vainly to get round it, but all the country was so wet and boggy that he was obliged to make for high land. He speakes of the river rising several times.

in June and July, and on July 15 the river was at its highest, laying the whole country under water. On July 25 he saw a flood come on suddenly in the Castlereagh. There can be no doubt, therefore, that the Darling was also in flood.

1829.—On February 2, 1829, Sturt discovered the Darling, near Bourke. The water was too salt to drink, and the water he says was evidently much below its ordinary level, and a ledge of rocks sticking up enabled them to walk over to the other side.

1835.—On June 1, 1835, Sir Thomas Mitchell embarked in boats at Fort Bourke, on the Darling, but in a few miles found so many rocks sticking up in the water that they could not navigate it, and in places the water was too salt to drink.

1836.—In 1836, Sir Thomas Mitchell, a few miles above the junction of the Darling and Murray, walked across the Darling dryshod.

1839.—B. Dickinson: Country dry, difficult to get water to take the cattle to Brewarrina. Darling was a chain of holes from Brewarrina to Yambecoona.

In December, 1839, some friends of M. Piesse, who had been with Sturt, went on to the Darling near Wentworth, and found it dry in many places.

1840–41.—River did not run at Yambecoona until 1841.

1844.—Sturt found the Lower Darling at its lowest ebb, 29 September; the river suddenly rose more than 5 feet, and by October 1st had risen more than bank high.

1845.—August 1845, M. Piesse: Darling had less water than in 1844, in November the same part was dry.

1846.—M. Piesse: I continued on the Darling during November, December and part of January, 1846; the river was dry all the time, in many places ½ mile dry The Darling a chain of water-holes from Pooncarie to Wentworth.

January, 1846, B. Dickinson: Darling very low, crossable anywhere on horseback.

E. Morley, J.P., occupied Euston station, then the furthest out station. This and two following seasons very dry.

1848.—1848 was a very wet year at Sydney, Port Macquarie, and Port Stephens. No record at Brisbane.

1849.—B. Dickenson: We had a terrible drought in 1849, lasting all the year 1849, all 1850, and all 1851.

1850.—E. Morley, J.P.: Early part of this year Messrs. Mackinlay M'Callum, and Morley went up the Darling looking for new country, and, after a thorough exploration of the Darling country, decided to take up country round Menindie. The whole course of the river for 60 miles above Menindie was only a chain of waterholes, in some places miles apart, and good feed in the river bed.

B. Dickinson: Drought all the year, no grass, no salt-bush cattle bogged in the water-holes.

1851.—B. Dickinson: Drought all year. E. Morley, J.P.: Dry year.

1852.—A. Ferguson: We had heavy rain in June, 1852, and a good flood in the Castlereagh, the first for eleven years.

B. Dickinson: There was a good deal of rain in 1852 on the Darling, and the river was continually running a good stream until 1855, when I left.

E. Morley, J.P.: Splendid rain all through Riverina in 1852.

1858.—August, 1858, Mr. Suttor says the country appeared to be suffering from drought.

1859.—January, 1859, Mr. Suttor says, two steamers passed up, and one reached Brewarrina; so that there must have been then a good flood in the Darling.

1859-60.—Seasons good, end 1858 to end of 1860. Mr. Suttor.

1861.—Mr. M'Intosh: A flood in the river and after that a drought.

1862.—Mr. Hatton, Louth: River dry for miles; only time it was as bad as early part of 1886.

1862.—In February river got very low, steamers stuck above Wentworth.

The river gradually dried up.

1863.—February, 1863. October, 1863, the Darling rose 38 feet at Cultowa—Mr. Suttor; March, 1863, the Darling came down in great flood.—J. S. M'Intosh.

1864.—Mr. Suttor, 1864: The highest flood on record, reached 42 feet at Cultowa.

Mr. Quin, Wilcannia, says the 1364 flood there was about 2 feet 6 inches higher than the present one, October 6, 1886.

Mr. Suttor: Seasons good, 1863 and 1864.

Greatest flood on record; Mr. T. Cadell says the water extended over the country 70 miles back from Bourke.

Water in March up to window-sills in main street of Bourke for 7 weeks, high all winter, and another flood in September nearly as high as that in March.

(Tolarno Manager) Reid's Lake was filled with water at this time, for the first time within the knowledge of the white man; the flood of 1870 did not reach it.

Mrs. E. J. Spark: The flood in September this year was nearly as high as that in March; at Bourke horses had to swim a mile in order to get over it. The king of the blacks told Mr. E. J. Spark that he had never heard of such a high flood before. The reason of the great flood in March was, the rain was general, and all the water from the tributaries met in the Darling.

Thomas Johnson, captain of the "Jolly Miller," steamer, said 1864 flood was up to window-sills in Bourke where Commercial Bank now stands.

Mr. Hatton, Louth: 1864 flood 45 feet above summer level.

Mr. Conder: The river fell very little while I was there in August and September. Mr. Bloxham says: In two years I have seen four large floods in the Darling, each one left from ½ inch to 1 inch of mud as a deposit.

1865.—In September, 1865, Mrs. Forde says the Darling was dry about Menindie, with grass growing in the bed from September, 1865, to May, 1866.

Mr. Suttor: From 1865 to part of 1869 seasons got worse, the drought being fearful.

1866.—Heavy rain storm in January, 1866, like that of 1885. —J. G. M'Intosh.

Mr. Suttor: The river rose 18 feet at Cultowa from local rains.

Mrs. Forde: River dry all the year to May.

1867.—River rose in February, 1867, to a high flood.—J. G. M'Intosh.

Mrs. Tully, Wilcannia: The river here was dry for some months in latter part of 1867.

J. G. M'Intosh: Flood in February, 1867; nearly as high as that of 1870, for I had nearly as much trouble to ride in to Bourke in 1867 as in 1870.

1868.—J. G. M'Intosh: Darling very low in 1868.

Mr. Quin, Wilcannia, had on two occasions known two years' clip of wool sent away together, viz., those of 1868 and 1869 and the present and past seasons' clips.

Mr. Suttor: The drought broke up in March, 1869, with good rain, but it became very dry again to April, 1870.

1869.—Mr. Tully, Wilcannia: In 1869 he thought one-third of the stock perished from the drought.

John Mackay, Louth, went up the Darling with stock in 1869, used to camp in the river bed; one night a flood came down upon them, and next morning they had to cross 8 feet of water.

J. G. M'Intosh: The Darling was a "banker" in winter of 1869.

1870.—Tolarno: 1870 flood was not high enough to fill Reid's Lake. (*See* 1864 and 1870.)

Mr. Quin, Wilcannia, remembered the floods of 1870 to 1873; the first was the highest.

Mr. Tully also remembered the floods of 1870 to 1873, that of 1870 was about 1 foot higher here than the present flood (1886), September, which was 37 feet 6 inches.

Mr. Hatten: The 1870 flood at Louth was 43 feet; about summer level.

1871.—January, heavy rains in New England in 1871.

1872.—J. G. M'Intosh: Very heavy rain, and floods in the Darling.

1873.—J. G. M'Intosh: Very heavy rains, and floods in the Darling.

1874.—J. G. M'Intosh: Floods in the Darling, February and March; steamers came up to Brewarrina until October. Rain began 26th January, 1874, and made such a big flood in the Castlereagh that it was feared Coonamble would be washed away; but the water broke over into the Merri Merri. and so got away.

1875.—J. G. M'Intosh: Freshes in the Darling.

1876.—J. G. M'Intosh: Steamers running to Brewarrina until September.

1877.—J. G. M'Intosh: Floods in the Darling in early part of this year.

J. J. Haydon, Wilcannia: River lower in middle of 1877 than in end of 1885; 18 miles above Wilcannia river dry for $\frac{1}{4}$ mile, and in other places it had ceased running.

1878.—*Wilcannia Times* states that steamer "Princess Royal" was first boat to put in an appearance since the rise in the river on Monday afternoon, and she went on to Bourke, 13th March, 1878.

J. G. K'Intosh: Fresh in the Darling, March, 1878.

1879.—Reid's Lake filled again, December 2, 1879 (*see* 1870); thence to 1885 it has not been filled.

From this year onwards there are complete records of the state of the Darling at Bourke in the Rain and River Results.

In the pages which follow I have collected together all the available facts relating to the Darling River floods. I believe there are others in possession of many old residents upon that river, and I hope this attempt to record the Darling floods will induce any who can do so to aid me by sending anything they can remember upon this subject to me.

Captain Sturt, as we all know, discovered the Darling on the 2nd February, 1829, and found it very low and as "salt as brine." His short account of the discovery is intere-ting, and forms one of the links in our chain this evening.

Sturt, Vol. 1, p. 85.

"February 2, 1829.—The tracks of the natives assured me that water was at hand, but in what direction it was impossible to guess. As the track was leading northerly we took up that course, and had not proceeded more than a mile upon it when we suddenly found ourselves upon the banks of a noble river. Such in truth it might be called, where water was scarcely to be found. The party stood upon the bank, which was from 40 to 45 feet above the water. The channel of the river was from 70 to 80 yards broad, and enclosed an unbroken sheet of water, evidently very deep, and literally covered with pelicans and other wild fowl. Our surprise and delight may be imagined. The banks were too steep to allow of our watering the cattle; but

the men eagerly descended to quench their thirst. Nor shall I ever forget the cry of amazement that followed their doing so, or the looks of terror and disappointment with which they called out to inform me that the water was so salt as to be unfit to drink. On a closer examination the river appeared to me to be much below its ordinary level, and its current was scarcely perceptible. Mr. Hume, with his usual perseverence, however, after walking some distance, found a reef of rocks in the river, and on these crossed to the other side and found a small pond of fresh water. These rocks were subsequently found to be composed of indurated clay. On the 6th February we discovered some springs in the very bed of the river, with a considerable stream gushing out. They were, however, brine springs, and I collected a quantity of salt from the brink of them."

And there the matter ended for nearly six and a half years. There was a great salt river in the west, and nothing more was heard of it until Sir Thomas Mitchell was sent out with a party fully equipped to follow down the mysterious river to the sea; but the time was badly chosen—in fact could not have been worse, for the river was too low for navigation even by boats, and he was obliged to turn back. His own account of it says

Expedition into Eastern Australia.

"June 1st, 1835. Embarked in our boats at Fort Bourke, and proceeded down the river, but were stopped by rocks, or rather hard clay ledge. After getting the boat over this found the river so full of rocks for a mile that we could not navigate it even in a small boat, so returned to camp same day. Then took to our horses next day, and explored the river for some miles. It was not so rocky lower down. In places it was too salt to drink, and in others quite fresh, and at one place we found a spring of fresh water running out of the side."

At page 226 he says, "No fresh water anywhere, except in the Darling."

But Sir Thomas was not to be put off without another effort, and in 1836 he travelled on to the lower portion where it joins the Murray, only to find it dry enough to walk over.

Sturt also tried it again, strange to say, only to find it almost stopped running, and the third time when he came on to it in 1845 it had actually ceased to flow, and was only a chain of ponds.

Sturt, 1844, Expedition, Vol. 1, p. 107.

"The shallow and muddy waters of the Darling were at their lowest ebb in August, 1844, and the current was so feeble that I doubted if it flowed at all." 108. "The Darling must have been in the state in which we found it for a great length of time, and I

am led to infer from the grassy nature of its bed that it seldom contains water for any length of time ; if it did, the grass would be killed. 24th September, 1844. After making four days journey up the river, and finding abundance of grass in its bed, while the country all round was in bad condition," he says.

"The banks of the river" (p 112) "were covered with a thick even sward," and on p. 117, on September 28th, when near what is now called Pooncarie. "The river was still as low as ever ; but on the morning of the 29th, when we got up it had wholly changed. In a few hours it had been converted into a noble river, and had risen more than 5 feet above its recent level, and its muddy waters were carrying everything before them." P. 119, on the 1st October, "The Darling had now risen more than bank high, and some of its flats were covered with water."

On 24th February, 1882, a similar sudden rise in the Darling at Pooncarie took place, and in four days the water rose 14 feet, and by the records we know that the rise began at Bourke on the 5th, or nineteen days before. I mention this to indicate the probable period between the rise at Wilcannia and Bourke in the 1844 flood.

When at Wilcannia, on the return from his north west expedition on 24th December, 1845, vol. ii., p. 117, Sturt says: "The Darling at this time had ceased to flow, and formed a chain of ponds, and the lagoons and creeks in the neighbourhood were quite dry." (P. 119.) "The Darling had less water in it than in the previous year before the flood."

1844-45. In a letter to the Sydney *Herald*, in 1846, M. Piesse, who was one of Sturt's exploring party, says :—

"In 1844, when on the Darling between Laidley's Ponds (Menindie) and the Murray in August and September the river was running a smooth clear stream, but in many places I walked across it only knee deep." (Sturt mentions a flood which came on there suddenly on 28th September.) "In August, 1845," M. Piesse says, "I ran the river down from Laidley's Ponds. It was a smooth, clear stream, with less water in it than it had in 1844. In November, 1845, I went on to the Darling there again, expecting that a flood like that of 1844 had come down, but the river was dry all that month. All December, and part of January, 1846, it was nothing but a chain of ponds, in some places divided by dry bed for half a mile ; and in 1859 some friends of mine found the bed of the Darling dry for 30 miles above its junction with the Murray." In November, 1845, the back water of the Murray had flowed 22 miles up the Darling.

It is interesting to look back at these early attempts to solve the Darling riddle, and note the uniform misfortune that befell them all, as if owing to some fatality the driest years were always taken to explore the Darling. Sturt went in February, 1829,

August, 1844, and December, 1845 ; M. Piesse, in August, November, and December, 1845, and January, 1846 ; and Sir T. Mitchell, in June, 1835, and December, 1836, and all found it a chain of water-holes, or little better, saving one fresh, noted by Sturt. Nor is it surprising that settlers were slow in taking up country which had been seen at its worst. In 1839, however, a station was taken up 20 miles below Brewarrina,—again, you see, in one of the worst droughts ever known, and by a strange fatality, the next attempt was at the Wentworth end, in the great drought 1849-50. It is not to be wondered at, then, that from both the report comes that the river was dried up to a chain of water-holes. Mr. Dickenson tells us that the river ran during 1852, 1853, 1854, and 1855, until he left. There is, however, a little contradiction about this period, but I think his statement is correct. 1860 was a very wet year all over the Colony, and as far north as Brisbane, and the few records we have for New England in that year show heavy rains. So that I have no doubt there were floods in the Darling then, and also in 1861 for similar reasons. At Armidale that year the rainfall was 25 per cent. in excess of the average ; in 1862 the rainfall was very small, and in 1863 the rainfall at Armidale was the greatest on record there, so that there can be no doubt about the state of the river then. In 1864, however, the rainfall at Armidale was not so heavy ; so that the great flood of that year must have been due, in great measure, to Queensland rains.

A small work, called "Ten Years in the Interior," says, "In the beginning of 1864 the Darling rose sometimes 3 feet in 24 hours, and as floods were of frequent occurrence, no danger was anticipated at first ; but on 15th March the water rose up to our house, and on the 18th we could not light our fires. Our house stood high above the Darling, where, the blacks said, no flood had ever reached, but we had to leave it and go to a sand-bank, where we were prisoners for seven weeks, before we could return to our house."

In 1864 flood Mr. John Kelley kept the house in Bourke known as "Tattersall's," and had to make an embankment round it 3 feet high to keep out the water, and in the end was obliged to repair the leaks in the embankment with bags of flour, there being no more earth dry enough for the purpose.

J. G. M'Intosh's Recollections of the Darling River.

"My experience goes back to 1861, when I first came to Wentworth. The river was pretty low then, but there had just been a flood. In 1862 the river commenced to get very low, and I can well remember two new steamers, the "Lady Daly" and the "Settler," trying to get up the Darling, somewhere about October of that year. They both got stuck 30 miles above Wentworth. Their goods were discharged, and a large shed made, which I was sent

up to look after. It is from this fact that I have such a knowledge of how the river was then. From the time that I went up till about February, 1863, the river kept getting lower, until it became perfectly dry, and as there used to be teams coming to me for loading, I used to get all the news of the state of the river. All the way to Bourke it was only a chain of water-holes.

"I remember Mr. Scott, of Parra, a station only 3 miles above where I was camped, saying to me, in his broad-Scotch, 'Eh, mon, McIntosh, when I first came on the river I saw young gum-suckers growing in the bed of the river, but that is a long time since, and I have seen nothing like what it is now since then.'

"As far as I can tell, Mr. Scott arrived on the Darling about the year 1839 or 1840.

"In March, 1863, the Darling came down very heavy, owing to Queensland rains, and from that time until September, 1864, the river was nearly always a 'banker.' After this it commenced to subside.

"In April, 1864, we had our last rains for that year, and from that out until January, 1866, not more than half an inch of rain fell on any part of the Darling from Bourke to Wentworth. I was travelling the river very often then.

"During the winter of 1865 the river was extremely low, the billabongs being nearly dry. There were white frosts the whole of the winter, and the cold was so severe that it killed the fish in the river—at least, that was the prevalent idea.

"Although there had been no rain for such a long time, still stock would have done well if they could have got water, as there was plenty of rough grass left out back (the country being very lightly stocked); but as no water was conserved, all the stock had to come to the front, which became very bare in places, especially where the flood-waters had gone over.

"About November, 1865, the river was again very low, and at Dunlop, 80 miles below Bourke, I could jump over it. At Gundabooka the water was so salt from saline springs or drainage that you could not drink it without putting something in it.

"In January, 1866, there was a very heavy local rain, lasting for two days, but it did not rise the river anything to speak of. We had no rain about Bourke from this date until the 21st, 22nd, and 23rd of June, when we had a very heavy fall, but it seemed to be only a local rain, as the river did not rise. In September it was very low, and kept so until about February, 1867, when the Queensland rains sent it up, and then on the top of these came our own local rains. This was the time of such disaster in the Macquarie River from the floods there.

"The flood in the Macquarie in 1867 was far more disastrous than the 1864 flood in that river, but was not so high by several feet in the Darling, as the other rivers did not come down with it.

"There was a man with his family on the Bell River washed right off his house in this year. I remember well reading about it. The man was saved, with one son and daughter, who swam to a tree, but the mother and all the younger branches of the family were drowned. If my memory serves me right, there was a bridge being built at Wellington at this time. When the contractor was asked the reason of his not getting on with his work, he stated, I think, that there had been sixteen rises in the river that winter.

"The flood was so high that at Mr. Ryrie's, below Dubbo, the horses swam over the fences of the paddock.

"After the flood in 1867 the Darling subsided very much, and in 1868 it was very low. All the bars below Bourke were so dry that a boat could not cross over them. There was one in sight of Dunlop House that I have often crossed, stepping from stone to stone, about May of that year. After this the river commenced to get lower, and we had no rain in 1868 except a few showers in the winter; in fact, all the tributaries were dry, more especially the Macquarie. Out in Queensland, where I was in January, 1868, I believe salt was got off the bottom of one of the holes of the Cuttaburra, an ana-branch of the Warrego, a thing I have not heard of having been done since.

"About January, 1869, a few showers commenced, and in March and April, about Bourke, we had some fine rains, with a splendid winter, the river being a 'banker.' In February, 1870, we had the commencement of the great wet season.

"It is a singular thing that I happened to be in Bourke the three great floods. More correctly speaking, I got there just as the 1864 flood subsided. I know the mark well that used to be shown years afterwards, both in Ross & Co.'s store and Sly's public-house.

"I rode in from West Bourke when the flood was at its highest, in 1867. I was living only 60 miles away: and a great job I had to ride in. But it was a greater ride still when I went in June, 1870. I remained at Bourke in this year for about three weeks, when I thought it was time to get away. I believe that if the Warrego had come down in 1870 equal to what it did in 1864, along with the other tributaries, the flood would have been as great as it was in 1864.

"I remained in New South Wales, about Bourke, until August, 1870. I then went to live at Charleville, in Queensland. After passing such a wet winter, imagine my astonishment when I got to Cunnamulla, just a little way up the Warrego, to find the grass very dry, there having been no rain since February. In October of that year (1870) it set in very wet, and continued so until the middle of December.

"After I got to Bureuda, 60 miles above Charleville, about the end of 1870, it rained constantly from September to December,

and I know the Warrego was flooded the whole of that time; so there must have been a fair fresh in the Darling that year up to Christmas.

"In 1871 there were no January or February rains in Queensland. It was very dry all the winter, there being only one slight shower about Charleville in July.

"Out on the Paroo, Bulloo, and Cooper's Creek it was very dry. To give an idea of the mildness of the season, in June, on the Bullo, I got dishfuls of tomatoes as ripe as they would be in their proper season; and we all know how sensitive they are to cold or wet.

"I started out in May, 1871, from Charleville to take the census, and travelled right out to Cooper's Creek. All the time I was out there was not a shower; so, unless there were heavy rains from New England and the Macquarie country, I don't think the Darling could be very high.

"In 1872 we had glorious rains in Queensland; all the rivers were flooded. There were good rains also about Bourke; so that there must have been a good fresh in the Darling in February and March of that year.

"In this year (1872) I ran down the Warrego, and hit the Darling in May. It was pretty low when I got on to it. We had very steady rain for about three days in June, but it did not rise the river then, as I had 10,000 sheep for the Melbourne market, and we made a bridge of the punt and a few planks at Wilcannia and got over without any trouble. It made a good rise afterwards, and there were good rains right up to September, so that when I got to the Lachlan in August it was 'bank and bank.' When I got to Wentworth, on my return, in November, 1872, the river was low. About the latter end of that month I started up the Darling. About the 1st of December there was a 24-hours' rain, and there were several showers this month up to Christmas week. On the Culgoa it rained very heavily, and the river came down a 'banker.' When I got across to the Warrego it was also up, so that there must have been two good freshes in the Darling before the end of 1872. In 1873 there were glorious rains again in Queensland, and also about Bourke during the early part of the year, which sent the river up again. About this time I started for Melbourne with another 10,000 sheep, and changed my route to my sorrow. There was dry weather from March to Queen's Birthday. I left the Warrego at Eringonia and came in at Warrawenna, on the Culgoa. I travelled up to Colless's public-house, where I found a slight fresh in the river, but nothing to speak of. When within 6 miles of Brewarrina, on the 23rd of May, 1873, rain set in about 9 o'clock p.m., without the least warning. It came down so smartly that I had to get up and see that the sheep had dry camp. It continued raining all night. I pushed on in the morning to get across the

river, in case a fresh should come down. I got across the pontoon all right and camped on the reserve. Next morning there was such a fog as I have not seen in the salt-bush country before or since. It cleared up (7 to 8 inches rain fell) about 11 o'clock, when I thought we were going to have some fine weather; but on the 27th May, 1873, wet weather set in, and during my thirty-three years in the colony I never have seen, before or since, so much rain in such a short time. The local rain alone put the Marra Creek a 'banker,' and the Barwon was fully 10 feet deep. I can safely say that for twenty-one days it rained incessantly, more or less; as all that time we never had a dry blanket, and many is the night I piled up salt-bush, not to get a dry place to lay on, but one to stand on only.

"There were heavy rains up to August. At what they call the Bogan Gates there was a terrific thunderstorm in the early part of July, 1873, so that there is no doubt the Darling was a 'banker' those months.

"In the early part of January, 1874, I left Melbourne. I got to Hay about the middle of month. Without the least warning rain set in while we were at lunch. I had ridden 30 miles that morning, and it did not look the least like rain. It rained for about twenty-four hours. I then started through back country for Bourke. Found on passing Cobar that the rain had been terrific about the time I had been in Hay. I had to ride through 30 or 40 miles of water going to Bourke, the water having had no time either to evaporate or drain away. I found the Darling rising very rapidly. There were splendid rains also in Queensland up to the end of February. The winter of 1874 was very dry; no rains except a shower or two in August and September; but nothing to speak of. The river was pretty low all the winter, although steamers were able to come up to Bremery for wool as late as the end of September or some time in October; but at this time the river was commencing to get lower. We had no rains about Bourke or Brewarrina in 1875 until May, except a few showers; but the Bree and Culgoa kept running more or less all through the summer, as well as the Barwon, and these kept a nice fresh in the river. We had some very nice rains through the winter about Brewarrina, and there were nice freshes came down, but nothing to speak of.

"There was a nice fresh in the river the early part of 1876, and right up to shearing time Queensland waters kept coming down, and the steamers were able to run up to Brewarrina well into the early part of September. After this the river commenced to fall, and got very low.

"In 1877 there were rains about Walgett and other places. In March the Barwon was well over its bank, and all the other tributaries came down heavily until May. In July river fell

pretty low again and kept so, when our real dry times set in; only slight showers up to the end of the year.

"In 1878 the season had broken about Coonamble and Dubbo; but it did not do much good to the Darling. All the Queensland tributaries quite dry, and no rise to speak of in the Barwon, which I walked across 60 miles above Walgett in May. Things kept getting drier until end of year, when I took 24,000 sheep belonging to the Bishop of Newcastle on to the road for grass; we had **plenty of water on the Birie River.**

"Six days before Christmas, 1878, I had to go from Coonamble to Brenda, on the Culgoa, within 7 miles of the Queensland border, which is a distance of 160 miles. I was detained at Brenda until two days before Christmas, and I rode the 160 miles in the two days, and well I know that all the creeks were dry, and **the Barwon only just running.**

"In 1879 I got back to Brenda on the Culgoa in April. The creeks were rising very rapidly, and in June there was a great rise. The Darling rose very steadily all through shearing, and kept rising until all the tributaries were 'bankers,' and kept well up until November. I had to travel down to Wilcannia from Goodooga, and had to strike right out on to the Warrego, thence on to the Paroo, and run it down to get there.

"In 1880 the Darling was no great height until the winter, when there was a good rise. All through shearing the Queensland waters came down a great height, and kept the river well up **until the end of the year."**

In the Appendix will be found notes of the river, 1858 to 1870, and river measures for 1870, kindly given to me by Mr. Suttor, which cover part of the same period as Mr. M'Intosh's history.

Recollections of the Darling River.

Mr. Basil Dickinson says, under date 18th November:—"I first visited the Darling in 1839, and took up a station called Yambecoona, 20 miles below Brewarrina, then called the Fisheries. This was the lowest station on the river for many years after that. When we got there the country was suffering from a long drought, and it was with difficulty we could get water for the cattle on the road from Liverpool Plains to the Darling. That river was then a chain of water-holes from Walgett to Yambecoona, and it did not run until 1841. In 1846, again, the river got very low, and could easily be crossed on horseback in many places. Again, in 1849, 1850, and 1851 we had a terrible drought on the Darling—no grass, no salt-bush, and the river so low that the cattle used to get bogged in it. In 1852 there was abundance of rain on the Darling, and the river continued running a good stream up to 1855, when I left that district. By that time many other stations had been **taken up below ours."**

Mr. E. M. M'Kinlay, under date November 19, 1885, says:—"On Black Thursday, February 6, 1851, I left Melbourne on a journey to the Darling, and travelled nearly as far up as Wilcannia. After forming the station we had to camp with our horses in the bed of the river, as there was not a bite of grass to be had away from it. The bed of the river was then, and had been for months, quite dry, with the exception of small water holes at considerable distance from each other, and around these grew a little green herbage, which kept life in our poor horses. At this time the squatters had not been long in occupation, but, to my surprise, they did not seem uneasy about the condition of the country. At a station about 150 miles from Wentworth, on the S.E. bank of the river, I saw a spring of cool, clear water running out of a small hollow sapling that had been inserted into the bank."

Mr. D. F. Mackay, under date November 21, 1885, says:—"In June, 1865, I travelled down the Darling from Brewarrina to within 50 miles of the junction of the Darling and the Murray. The country was a perfect desert, and we had to feed the cattle in the bed of the river, for there was not a vestige of grass on the plains. The bed of the river was dry for miles in many places—simply a chain of water-holes, some of which were quite salt, especially near Bourke."

Mr. J. F. Hayton, under date November 21, 1885, says:—"The river immediately above this town (Wilcannia) has stopped running in several places, and is lower than it has been since the middle of 1876. As, however, a flood cannot reach here for almost two months if rain were to fall now in New England, it is the general opinion that the water will be lower in the Middle Darling than it has ever been seen, and unless heavy rains fall at its source not later than February there is a prospect of the water supply being insufficient for the stock on the frontages. In 1876, at a point 18 miles above this, the bed of the river was perfectly dry for a quarter of a mile, and in other places the water had ceased running. It is almost in the same state now, and must be worse before a flood can come."

E. Morely, Esq., J.P., Claremont.

"As one of the early pioneers of the Darling, I would like to add my mite to the data you are accumulating, and from which I trust you may in time be able to furnish valuable hints to the dwellers in these dry regions.

"In the year 1846 I took up the station known as Euston. It continued to be the outside station on the Murray until the late John Mackinlay, some eight months afterwards, occupied country lower down. So far as I can distinctly recall the first three seasons there, they were dry, and the rainfall probably between 7 and 10 inches.

"In the early part of 1850 Messrs. Mackinlay, M'Cullum, and myself went up the Darling beyond settlement in search of new country. After a thorough exploration we decided on the country around Menindie, Parmamaroo, and T'dindionalogie, the latter falling to me by lot. The whole course of the river to a point about 60 miles above Menindie was then extremely dry. The river was in fact a chain of water-holes, in some places miles apart; but there was good feed for the horses in the river bed. The seasons continued dry until 1852, when splendid rains fell all through Riverina. After 1853 I did not again see the Darling. During the early part of 1852 I remember the blacks coming in to report a fresh coming down the river. We had to wait over a day before the water reached my station, and a most interesting sight it was to watch the living waters filling up each hole, and then rising suddenly and silently to a little wall of water between 2 and 3 feet high, and pass onwards. During my fifteen years on the Lower Murray I can recall only two good seasons, in the others the rainfall may have ranged from 5 to 15 inches. I sold out in 1861."

Wm. Camper, 26 May, 1886.

"The report that a dray passed over the river dry at Wentworth is not true. The Darling River at the present time is about 8 inches below summer level, and is neither rising nor falling. There are many places in this river which are fordable, especially at sand-banks. The river is dry about 45 miles above Wentworth, and also in places about Pooncarie and Menindie. The Darling cannot run dry at Wentworth, as it is backed up by the Murray. When the Murray is in flood, and the Darling low, the Murray water runs 35 miles up the Darling.

"The Murray at the present time is very low—lower, I think, than I have ever seen it before, and I have lived on it for over twenty years. At the junction it is fordable, owing to the extensive sand-banks; but there would be great danger in fording it, owing to the boggy banks, and there is always more or less risk of getting into a deep hole.

"There is plenty of water in the Murray, in many places over 20 feet deep; but over the sand-banks and rocks there is often only a few inches of water. If the Murray ran dry, as has lately been stated, it would be a bad day for Australia.

"For some years past the floods in the Darling have been of very short duration, owing to the floods in this river taking place when the Murray was low. When this is the case, the Darling waters run off so rapidly into the Murray at the junction that a rise of 30 feet at Wilcannia scarcely makes any impression on the Darling at Wentworth, except that the current runs at double its ordinary speed.

"During last month I have had opportunities of seeing the Murray in many places between Wentworth and Goolwa, S.A., and, although in many places the rock show above water, and the river is very shallow at the sand banks, in no instance did I see it dry."

Mr. W. H. Sutton, of Cangoura, says, under date March 11th, 1886: "I went to the Darling in 1857, and in May and June the river was bank high; this was about 100 miles above Wilcannia."

Mrs. A. F. L. Cole, under date 3 January, 1887, says: "I lived at Tapio Station, 15 miles up the river from Wentworth, and remember that before 1848 the river was a chain of water holes, with small streams running between; but in February, 1848, the water came down the river like a wall 10 to 12 feet high, much to our surprise, as we had no warning that a flood was coming. The flood carried everything before it; but the following year, 1849, it was again a chain of water holes, so that we could cross it at many places. In the winter of 1852 there was a great flood in the Murray, and its waters flowed up the Darling as far as Pooncarie, but in October and November the Darling water came down with a strong current, and being backed up by the Murray water, the river rose over the banks, sending water out back to the greatest distance I ever saw it, excepting in the great flood of May and June, 1864, the highest flood ever known. So much water got into the lakes and hollows on the east side of the Darling in 1864 that the face of the country was quite altered for years after it."

Mr. Sutton's Notes at Cultowa Station—1858 to 1870.

First occupied, 1858; brought on cattle, August, 1858, at which time most of the country between junction of Bogan and Mount Murchison, with exception of Cultowa, appeared to have been suffering from drought, as there was not much feed generally, and that very dry. There was plenty of water in Martilli Billabong and Oonondoo, and Wongalara.

First steamers up the Darling were the "Albury" and "Gemini," in January, 1859, the latter going as far as Walgett. Gundabooka Station then just occupied.

Seasons good from end of 1858 to end of 1860.

Drought, 1861 to 1863.

Seasons good, 1863 and 1864. From 1865 they gradually got worse until 1868 and part of 1869. They culminated in the most disastrous drought known since the settlement of the colonies, an immense number of sheep and cattle perishing from sheer starvation in New South Wales, Victoria, and Queensland. Sheep on many of the unfenced runs became too poor and week to admit of their being shepherded, and had to be turned loose. Many died in fenced paddocks in Victoria, where country was thickly stocked;

in some cases nearly all died. Losses during drought, one to two thirds ; estimated loss by starvation in whole colonies, 1,000,000 and over.

Great drought broke up March, 1869, raining March and April, producing good winter feed.

But no more rain coming, the summer of 1869 and 1870 was a terrible one at Cultowa, there being no rain from March and April, 1869, to April, 1870, heavy enough to make anything grow.

The lakes were filled by floods in river several times from 1858 to 1864. (April 16th, Mr. Suttor says the river up 30 feet 3 inches and just running into the lagoons). The water-holes at Martilli, Oonondoo, and Wongalara during that time were seldom empty, and then only for a very short time ; but from early 1869 to April, 1870, the lakes and water-holes continued empty.

The highest floods since the Darling was settled were October, 1863, and March–April, 1864, the former reaching within 16 inches of the high river bank at Old Cultowa, or nearly 38 feet above summer level ; while the latter (known as the "Great Flood") rose 3 feet in the old house, or 42 feet above summer level. Towns of Walgett and Bourke flooded, and others on the tributaries of the Darling ; but since the great flood of 1864 until that of 1870 there has only been one flood high enough to run out in the billabongs, and that was in May and June, 1867 ; but it only partially filled the lakes, and fell again rather suddenly.

The greatest rainfall occurred here in the months of February and November, two great falls in the former and one in the latter (November, 1858, the other years I forget) filling large water-holes in the billabongs, and leaving sheets of water in places on the plains.

There was a tremendous fall of rain on some parts of the river and back country (known ever since as the "January Rain") in January, 1866, which rose the river 18 feet at Menindie, a thing unknown from local rains before, and large lakes in the back country, not connected with the river, were filled and lasted three years ; but here small water-holes were not filled, although rain fell during greater part of three days.

Summer temperature very high, averaging 100 degrees in the shade for weeks (and twice it rose to 100 degrees at sunset); extreme, 110 in coolest part of house. Autumn, winter, and early spring generally delightful, with occasional frosts in coldest part of winter (July or early in August).

Summer of 1869–1870. Country fearfully dry, most trying. March and April rains of 1869 not doing more than provide the winter feed. Reflection of sun's rays from the parched and naked earth, together with clouds of blowing sand and dust, accompanied by hot, scorching winds, most intolerable ; blown sand covering up fences about draughting yards. Hot winds and boisterous gales unusually prevalent, sometimes continuing three or four days,

completely darkening the atmosphere with clouds of dust, prevent ing objects a short distance off from being seen. Wells pumped dry at house every day to try and keep things in garden growing.

Notwithstanding great dryness and absence of rain here to Murtee during past summer (1869–70), the season in almost every other part of New South Wales magnificent; even so close as Nelyambo and Walloo there were good falls of rain two or three times which quite missed us, whilst at Billilla and Culpauline and Tintinalogy there were fine rains.

River Observations made at Cultowa, New South Wales, during the month of March, 1870.

Date.	River above Summer level.	Remarks.
	ft. in.	
1		
2		
3		
4		
5		
6		
7	.....	River began to rise about 7 ft. (*See* Note below.)
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28	16 2	Run in most deplorable state for want of rain; strange this summer should be such a splendid one everywhere else, fine rains both up and down the river, and all to miss the country from here to Murtee. River began to rise here about 7th instant from heavy rains at Winbar and Dunlop.
29	17 4	Some light showers last night and this morning, rising river 1 ft. 2 in.
30	18 6	
31	19 6	

River Observations made at Cultowa, New South Wales, during the month of April, 1870.

Date.	River above Summer level.		Remarks.
	ft.	in.	
1	20	6	
2	21	3	Cloudy, thunder and lightning; river just up to butt of bushy-headed gum-tree on opposite side, just below boat crossing.
3	22	1	Nice light showers last night.
4	22	10	Have had splendid rain at Calcuarack, Nelyambo, and Walloo.
5	23	6	Shower in evening; heavy rain from Wintanbilla to Bourke.
6	24	4	
7	25	0	
8	25	8	
9	26	3	River just over the road at Martilli, Billabong, and Warunda.
10	26	10	River just over top of chopped stump, near blacks' camp.
11	27	5	
12	28	1	
13	28	8	
14	29	3	The mailman reports river falling above Bourke, but rising again at Walgett.
15	29	10	The papers report great floods in the Burdekin, and other rivers in Queensland.
16	30	3	River just running into lagoon, near woolshed; papers report disastrous flood; Hawkesbury and Hunter in flood, and many other rivers.
17	30	9	Water rising fast at Martilli Billabong, above woolshed.
18	31	3	River into little hollow, just beyond blacks' camp, yesterday at 30 ft. 9 in.
19	31	8	River rose 5 in.; reached Wongalara to-day, through Weerunda.
20	32	0	First steamer from Wentworth to Bourke—eight steaming days—the "Maranoa."
21	32	5	Steamer, "Jupiter," arrived this morning; flood-water at Oonondo to-day.
22	32	10	Splendid rain last night, showers this morning.
23	33	2	Glorious showers to-day.
24	33	6	Water reached Wongalara to-day, a week after crossing Martilli bar.
25	33	9	Wongalara Lake and Billabong joined.
26	33	11	Occasional showers.
27	34	1	
28	34	3	Water rising fast in Coombimbi and Wongalara; numbers of swans in these lakes.
29	34	6	Scarcely any ducks this flood; hitherto have been great numbers.
30	34	8	No mailman this week.

River Observations made at Cultowa, New South Wales, during the month of May, 1870.

Date.	River above Summer level.	Remarks.
	ft. in.	
1	34 10	
2	35 0	
3	35 2	
4	35 4	Steamer "Maranoa" returned from Bourke to-day.
5	35 6	
6	35 7	The mailman reports river fallen at Bourke 3 ft. Contradicted later.
7	35 8	
8	35 9	River just touching gum-tree root at Old Cultowa.
9	35 10	Thunder; no rain.
10	35 11	
11	36 0	Fine rain last night and to-day.
12	36 2	Boisterous gales last night.
13	36 2	Frequent light showers; river stationary, just over gum-tree root at Old Cultowa.
14	36 3	The country too soft to ride over.
15	36 3	
16	36 2	
17	36 1	Two or three flying showers. The mailman seems to have given up travelling.
18	36 1	Frequent light showers.
19	36 0	Heavy rain last night, with thunder and high wind.
20	35 11	Thunder occasionally; rivers are all up. "Jupiter," steamer, has been four weeks up the river; perhaps she has gone to Queensland.
21	35 11	
22	35 11	Showery in afternoon.
23	35 11	Steady rain last night.
24	35 11	Showery last night; country completely saturated; too boggy to work cattle or horses.
25	36 0	
26	36 0	Some good pumpkins and other vegetables in garden.
27	36 1	
28	36 1	
29	36 2	
30	36 3	Steamer "Jupiter," from Bourke, reports river rising fast, and town of Bourke in danger of flood.
31	36 4	Heavy rain.

River Observations made at Cultowa, New South Wales, during the Month of June, 1870.

Date.	River above Summer level.	Remarks.
	ft. in.	
1	36 6	Heavy rain—large sheets of rain water in Bocarra, Yungulco, and other places, and country one vast quagmire.
2	36 7	Heavy rain at Bourke ; the townspeople asking capt of "Jupiter" to remain until another steamer came, fearing big flood.
3	36 8	
4	36 9	
5	36 10	
6	36 10½	Great floods in Murrumbidgee, Yass River, and all over colony, with loss of life.
7	36 11	Light showers ; news of big flood in Paroo ; Wentworth people alarmed at prospect of Darling and Murrumbidgee being in flood and submerging town.
	37 0	
	37 1	
10	37 2	
11	37 3	
12	37 3½	
13	37 4	Mailman reports river rising at Bourke.
14	37 4½	Papers full of disastrous floods all over N. S. Wales.
15	37 5	A few drops of rain, thunder ; great flood in Lachlan.
16	37 5½	Thick masses of rain falling.
17	37 8	Rain began last night ; raining all day.
18	37 8½	Rain last night ; showery to-day.
19	37 9	
20	37 9	
21	37 9	
22	37 9	Rainstorm last night ; water now all round us.
23	37 9	Run is too boggy to ride over.
24	37 9¾	Rain commenced at midnight till morning ; no mailman for three weeks.
25	37 9¾	
26	37 10½	
27	37 11½	Regular wet day ; began at 11 a.m. and continued until late at night.
28	38 0	
29	38 0½	Flood water keeps hemming us in.
30	38 1½	River now through fork of tree at Old Cultowa.

River Observations made at Cultowa, New South Wales, during the month of July, 1870.

Date.	River above Summer Level.		Remarks.
	ft.	in.	
1	38	2½	
2	38	3	
3	38	4	
4	38	4½	River falling at Bourke; but the Balonne is coming down a "banker."
5	38	5¼	Light showers.
6	38	5½	Bourke: River fallen 2 or 3 inches; light showers last night.
7	38	5½	
8	38	5½	
9	38	5½	
10	38	5½	
11	38	5	
12	38	4½	Light showers.
13	38	4¼	Rain after midnight and showery during day.
14	38	3¾	Light rain.
15	38	3	River has fallen 2 feet at Bourke, and 10 feet at Brewarrina, but floods coming down the Namoi and Culgoa.
16	38	2¼	Flying showers and more rain last night.
17	38	1½	Showery.
18	38	0½	Plenty of wild ducks about, blacks got about 300 eggs.
19	37	11¾	
20	37	11	Some smart showers.
21	37	10¾	Flying showers.
22	37	10	Light rain.
23	37	9	Light showers. Beaker writes me that 2 inches more would have flooded Bourke.
24	37	8¼	
25	37	7¾	
26	37	7¼	Few drops of rain.
27	37	6½	Showery.
28	37	6	I hear river only reached its maximum at Wilcannia a few days ago.
29	37	5½	
30	37	5	
31	37	4½	Slight rain, distant thunder.

River Observations made at Cultowa, New South Wales, during the month of August, 1870.

Date.	River above Summer level.		Remarks.
	ft.	in.	
1	37	4	
2	37	4¾	Raining. Rain set in about midnight, and rained steadily from N.W. till noon.
3	37	4½	Thunder storm last night.
4	37	4	
5	37	3¾	
6	37	3¾	Light showers. Strong west gale.
7	37	3	
8	37	3	
9	37	2¾	Light showers.
10	37	2¾	
11	37	2½	News of river rising again at Bourke.
12	37	2½	Violent thunder and rain storm.
13	37	2¼	
14	37	1¾	
15	37	1¾	
16	37	1¾	
17	37	2	Thunder and rain storm last night, and this morning good deal fell.
18	37	1¾	Boisterous W.N.W. gale.
19	37	1¼	
20	37	1¼	
21	37	1¼	Wet day.
22	37	1¼	Reports from Bourke of all the upper rivers being again in flood.
23	37	1¼	Reports of river rising slowly at Bourke.
24	37	1¼	
25	37	1¼	Raining after dark.
26	37	1¼	Raining this morning.
27	37	1¼	
28	37	1½	
29	37	1½	
30	37	1¾	
31	37	2	

River Observations made at Cultowa, New South Wales, during the month of September, 1870.

Date.	River above Summer level.		Remarks.
	ft.	in.	
1	37	2¼	
2	37	2½	
3	37	3	Rain last night ; drizzling showers to-day.
4	37	3	
5	37	3	
6	37	3	Strong gales.
7	37	3	Raining.
8	37	4	
9	37	3½	
10	37	3¼	Showery this evening.
11	37	3¼	
12	37	3	
13	37	2½	
14	37	2	Rivers falling all the way up.
15	37	1½	
16	37	1	Light showers.
17	37	0½	High wind.
18	37	0	
19	36	11½	News of another fresh at Walgett—5 feet in one night.
20	36	11	News of floods in Victoria carrying away railway bridge.
21	36	10½	
22	36	9½	Boisterous.
23	36	9	Strong gale all last night.
24	36	8½	
25	36	8½	
26	36	8	
27	36	7	Mailman reports river rising at Bourke and Walgett again.
28	36	7	Sprinkling rain, afternoon.
29	36	7	
30	36	7	

River Observations made at Cultowa, New South Wales, during the month of October, 1870.

Date.	River above Summer level.		Remarks.
	ft.	in.	
1	36	7	
2	36	6½	
3	36	7	River beginning to rise again here.
4	36	7¼	
5	36	7¾	
6	36	8¼	
7	36	8¼	
8	36	9¼	Boisterous windy weather.
9	36	9¾	Thunderstorm last night. Only a few drops of rain.
10	36	9¾	Mailman reports river falling at Bourke.
11	36	10¼	Light shower.
12	36	10¼	
13	36	10¼	
14	36	10¼	
15	36	9¾	
16	36	8¾	
17	36	7	
18	36	6	Sprinkling rain this morning.
19	36	5	Light rain fell last night. Thunderstorm with little rain, p.m.
20	36	4	Light rain with thunder and lightning.
21	36	2	
22	36	0	
23	35	8½	A thorough wet day.
24	35	5	A thorough wet night and showery day.
25	35	0½	
26	34	4½	More rain to-day. River at Bourke said to be rising again.
27	34	1½	Heavy rain last night; showery to-day. Cannot go out of house without walking in water or mud.
28	33	10½	Showery morning.
29	33	7½	Rain during afternoon.
30	33	4½	
31	32	10½	

River Observations made at Cultowa, New South Wales, during the month of November, 1870.

Date.	River above Summer level.	Remarks.
	ft. in.	
1	32 4½	
2	31 10½	
3	31 4½	
4	30 9½	
5	30 3½	
6	29 9½	
7	29 4	
8	29 0	
9	28 9	
10	28 7½	
11	28 7½	
12	28 7½	Rain this morning.
13	30 7½	Heavy rain early last night; rise in river.
14	30 6½	
15	30 6½	
16	30 7½	
17	30 9½	
18	30 11½	Light passing showers, p.m.
19	31 2½	Sprinkling rain.
20	31 5½	
21	31 8½	
22	31 11½	
23	32 2½	
24	32 5½	
25	32 8½	Thunderstorm, with light shower, this afternoon.
26	33 0	
27	33 4	
28	33 7	
29	33 9½	
30	34 0	

River Observations made at Cultowa, New South Wales, during the month of December, 1870.

Date.	River above Summer level.	Remarks.
	ft. in.	*Mosquitoes very bad this summer.*
1	34 2½	
2	34 4½	
3	34 6½	
4	34 8½	
5	34 10½	
6	35 0½	
7	35 2½	
8	35 4½	
9	35 6	
10	35 8	
11	35 9½	Bourke mailman reports big flood coming.
12	35 11	
13	36 0½	
14	36 2	
15	36 3½	
16	36 4½	
17	36 5½	
18	36 6½	
19	36 7	
20	36 7½	Strong south gale.
21	36 8	Light sprinkling rain.
22	36 9	Rode out to Moongur Sand-hill; cannot go further for floods.
23	36 10	
24	36 10½	
25	36 11½	
26	37 0½	
27	37 1	Mailman reports river at Bourke fallen 1 inch.
28	37 1½	
29	37 1¾	
30	37 1¾	
31	37 2½	

River Observations made at Cultowa, New South Wales, during the month of January, 1871.

Date.	River above Summer level.		Remarks.
	ft.	in.	
1	37	2¾	Flies and mosquitoes unbearable.
2	37	3	
3	37	3	
4	37	3	River within 14 inches of July flood (1870).
5	37	3	
6	37	3	
7	37	3	Thunderstorm and few drops of rain.
8	37	2¾	Thunderstorm and light showers.
9	37	2¾	
10	37	2½	Mailman reports river at Bourke fallen 16 feet; it has only fallen here about 1 inch.
11	37	1¼	Never experienced anything like the mosquitoes before.
12	37	0¼	Ducks plentiful.
13	36	10½	
14	36	8¼	Boisterous gales all night. Blacks from up and down mustering for corrobboree.
15	36	5	
16	36	1	
17	35	6	
18	34	10	
19	33	10	
20	32	8	News of another fresh in river at Bourke.
21	31	4	
22	29	10	
23	28	6	
24	27	0	Nearly all the blacks sick with chest and head complaints.
25	25	8	
26	24	7	
27	23	4	
28	22	4	Traveller reports no rise at Bourke in river when he left.
29	21	5	Thunder and sprinkling rain.
33	20	9	
31	.....		No report. *See* 27th February.

River Observations made at Cultowa, New South Wales, during the month of February, 1871.

Date.	River above Summer level.	Remarks.
	ft. in.	
1	.....	Raining.
2		
3		
4	.....	Started for Wilcannia.
5		
6		
7	.....	Thunder and wind storm last night, with little rain.
8	.....	Thunderstorm; steamer's paddles coming up by Wilcannia disturbed the cattle at night.
9		
10	.....	Returned to Cultowa from Wilcannia.
11		
12		
13		
14		
15		
16		
17		
18		
19		
20	.....	Sprinkling rain; steamer passed down to-day.
21	.....	Sprinkling rain.
22		
23	.....	Mailman reports heavy rain about Bourke, and river again on the rise there.
24		
25		
26		
27	.....	River has not got very low yet, as small freshes keep coming down.

River Observations made at Cultowa, New South Wales, during the month of March, 1871.

Date.	River above Summer level.	Remarks.
	ft. in.	
1	.....	Thunderstorm and little rain.
2	.....	There is plenty of feed yet—green feed on flooded flats.
3	.....	The river is rising here again, and visitor reports rising fast at Bourke when he left.
4		
5	.....	Great crops of fruit, figs, melons, and cucumbers.
6		
7		
8		
9	.....	A great deal of sickness about Wilcannia.
10		
11	.....	Steamer passed down this morning.
12		
13		
14	.....	River falling again.
15	.....	A few drops of rain. Feed beginning to get dry.
16	.....	Thunderstorm with little rain.
17		
18	.....	Light drizzling rain.
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30	.....	There has been a slight rise in river at Bourke, but mail-man reports it falling again.
31		

River Observations made at Cultowa, New South Wales, during the month of April, 1871.

Date.	River above Summer level.	Remarks.
	ft. in.	
1	.....	Steamer on her way up to Bourke called here to-day.
2		
3		
4		
5		
6		
7		
8		
9		
10		
11	.....	Wet night and showery to-day.
12	.....	Steamer passed down to-day.
13		
14		
15		
16		
17		
18		
19		
20		
21		
22	.....	Two steamers passed down to-day.
23		
24	.....	Last entry of diary.
25		
26		
27		
28		
29		
30		
31		

Mr. Sutton's journal does not give the river heights for February, March, and April. Mr. Trader, Telegraph Station-master at Bourke, replies to my questions as follows:—

State of the Darling on November 12, 1885.

Was the river ever so low before, and if so when? Yes, the river has been as low, and lower than it is at present, but cannot get the dates. Mr. Bloxham has on two or three occasions seen the river quite dry between Toorale and Bourke.

How far down below Bourke has the river ceased running? The Telegraph Station-master at Louth reports, "Can walk up bed of river here for over 100 yards." At Tilpa, 70 miles below Louth, the Telegraph Station-master reports, "River not stopped running but at stony bars there is only small stream running." At Brewarrina the Telegraph Station-master reports, "River has almost stopped running, except a little stream, which you can step across."

Has the river actually stopped running, *i.e.*, if you throw a piece of wood in will it not move, or will it go down stream very slowly, indicating that the water is finding its way slowly through the rock bars? The river has actually stopped running; no current whatever. Since the receipt of your note I have visited several of the stony or rocky bars, and found the rocks from 12 to 18 inches above the level of the water. Now, at North Bourke there is a sandy stretch, immediately below a rocky bar, 300 yards long, quite dry.

When did the river stop running? About or between the 25th and 27th October.

Where does the present level come to on the river gauges? I want to know particularly at what depth below what you call summer level does the river stop running? The water is now perpendicularly 3 feet below the level of the new gauge, and the river ceased running 2 feet below it. The river is said to be at summer level when below the gauges.

Is it true that the blacks on the river have been making canoes, saying that a very big flood is coming? There are very few blacks about here, and those that are here know nil about big rivers, or anything else, bar rum and tobacco.

October 30, 1885. The river is lower than for many years, and just short of a chain of holes. Three miles down from here it is absolutely dry right across, but the water has made a little gutter in the sand a few feet wide, through which it is running. It is full of fish in splendid condition, and the water is as clear as sea water.

Mr. Alexander Ferguson went to reside on the Castlereagh in 1840, has lived there ever since, and says there was no flood there like the one Oxley saw in 1818 until that of 1874. Oxley went over the flat country in a boat for some 30 miles, the water being from 3 to 5 feet deep. Mr. Ferguson and two others in the 1874 flood rode on horseback for 10 miles through flood waters from 2 to 3 feet deep.

Rainfall Observations given here to indicate the Rainfall on the Darling in the early years.

Made at Armidale, New South Wales, during the years 1859 to 1870.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1859	3·500	1·330	0·140	0·680	1·219	2·090	0·140	0·585	3·350	0·320	3·450	2·400
1860	0·880	..	..	..	..	..	..	..	..	3·230	2·630	1·520
1861	7·070	0·820	0·950	5·380	0·570	4·650	4·220	3·320	1·830	1·230	0·640	4·300
1862	2·200	3·870	2·580	0·320	0·760	2·120	0·440	0·740	1·690	0·280	0·270	1·900
1863	10·810	6·450	4·970	9·310	1·560	5·330	1·870	2·090	3·790	6·360	3·870	2·930
1864	1·420	11·010	7·150	1·260	1·330	4·630	4·750	8·230	0·010	0·030	3·030	0·010
1865	1·370	2·620	0·600	3·270	3·009	2·669	1·760	0·820	2·940	3·560	8·390	11·370
1866	4·600	4·000	0·100	0·700	2·100	6·200	4·000	1·200	0·500	3·800	9·200	3·200

Made at Brisbane, during the years 1859 to 1872.

1859	4·370	0·580	5·970	..	0·890	6·090	0·030	3·010	0·810	5·480	2·260	3·350
1860	2·540	9·640	6·580	7·550	0·190	0·960	0·490	12·390	4·180	3·350	3·690	3·140
1861	9·280	4·580	8·860	10·380	2·879	6·880	1·900	10·110	1·830	2·740	4·590	5·150
1862	4·250	2·610	6·870	0·790	2·210	3·000	0·510	0·060	2·710	0·450	0·990	3·880
1863	6·480	15·140	14·360	6·700	0·920	2·750	2·430	1·810	1·070	9·390	4·930	2·030
1864	4·470	9·330	1·540	0·130	2·630	3·020	3·040	5·120	0·380	1·340	2·360	2·340
1865	7·640	4·090	0·700	0·500	0·410	4·280	1·550	0·890	3·360	0·300	0·830	0·350
1866	..	6·940	0·810	3·090	3·320	8·620	1·970	4·480	0·700	3·930	1·360	9·500
1867	6·850	12·660	5·370	15·280	8·970	4·140	0·720	0·770	0·920	0·250	2·340	2·770
1868	7·220	6·740	0·600	1·700	1·150	4·260	5·510	0·700	1·870	3·640	2·260	0·500
1869	7·970	4·230	9·020	12·040	0·390	6·180	0·560	0·000	1·560	3·540	3·370	5·530
1870	4·920	3·060	34·040	4·610	2·810	3·110	6·150	1·940	0·740	4·790	8·490	4·420
1871	8·790	4·710	2·640	5·110	0·830	1·310	3·320	0·430	1·520	3·170	4·390	9·230
1872	8·370	6·850	7·890	0·320	0·260	2·260	3·900	0·910	1·810	1·460	6·250	8·940

Made at Burrundulla, New South Wales, during the years 1866 to 1870.

1866	3·630	1·760	0·900	0·240	3·060	1·160	1·940	2·080	0·140	2·500	1·420	1·530
1867	0·650	0·680	2·120	4·190	2·850	4·560	3·440	1·630	3·420	1·500	0·040	0·000
1868	3·470	1·150	0·000	0·110	0·830	1·370	1·790	0·800	1·370	0·450	1·040	0·950
1869	2·120	2·340	2·480	5·790	2·570	1·920	3·190	1·260	0·840	4·310	1·920	1·180
1870	3·390	1·740	6·290	9·190	2·640	3·010	1·650	4·420	1·920	3·810	3·670	3·730

Copies of all the River records at Bourke that can be found. In Mr. Suttor's notes will be found the River heights at Cultowa, Wilcannia, for part of 1870 and 1871.

***Observations of the River Darling, made at Bourke, New South Wales, during the year 1872.**

Date	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.	
	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.
																	ft. in.	min.	ft. in.	min.			ft. in.	min.
1															.....	.....	.....	.....	.....	.....			4 6	8½
2															.....	.....	.....	.....	.....	.....			4 8	9
3															.....	.....	.....	.....	.....	.....			5 0	7½
4															.....	.....	.....	.....	6 0	.....			5 10	6
5															.....	.....	.....	.....	.....	.....			6 2	6
6															.....	.....	.....	.....	.....	.....			6 6	6½
7															.....	.....	.....	.....	.....	.....			6 9	7½
8															.....	.....	.....	.....	.....	.....			7 0	7½
9															.....	.....	.....	.....	.....	.....			7 6	7½
10															.....	.....	.....	.....	.....	.....			8 6	6½
11															.....	.....	.....	.....	4 6	.....			10 6	6½
12															.....	.....	.....	.....	.....	.....			12 6	5½
13															.....	.....	.....	.....	.....	.....			14 3	5½
14															.....	.....	.....	.....	.....	.....			15 9	5½
15															.....	.....	4 0	.....	.....	.....			17 0	5½
16															.....	.....	.....	.....	5 9	.....			18 0	5½
17															.....	.....	.....	.....	7 6	.....			19 0	4½
18															.....	.....	.....	.....	8 9	.....			19 10	4½
19															.....	.....	.....	.....	9 10	6¾			20 6	4½
20															.....	.....	.....	.....	10 10	6¾			21 0	4½
21															S.L.	.....	.....	.....	11 4	6			22 0	4½
22															.....	.....	.....	.....	11 9	6			22 6	4½
23															.....	.....	.....	.....	12 0	7½			23 0	4½
24															.....	.....	.....	.....	.....	8¼			23 9	4½
25															.....	.....	.....	.....	.....	7½			24 3	4½
26															.....	.....	.....	.....	.....	6			24 11	4½
27															.....	.....	.....	.....	.....	6			25 7	4½
28															.....	.....	.....	.....	11 9	6¾			26 0	4½
29															.....	.....	.....	.....	.....	7½			26 6	3¾
30															.....	.....	8 0	.....	.....	6			27 0	3¾
31															.....	.....	.....	.....	12 4	6¾			27 5	3¾

No returns.

No return

* These observations were made for the Department of Harbours and Rivers by Mr. J. Moloney.

December.—Occasional thunderstorms the whole of this month; a good deal of rain has fallen. The Queensland and New England rivers are very high, which causes the rise in the Darling.

* Observations of the River Darling, made at Bourke, New South Wales, during the year 1873.

Date.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.	
	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.
			ft. in.	min.	ft. in.	min.	ft. in.	min.	ft. in.	min.	ft. in.	min.	ft. in.	min.	ft. in.	min.	ft. in.	min.			ft. in.	min.	ft. in.	min.
1			32 3	4½	28 2	6	11 9	6	3 3	9	1 1	12	28 10	3¾	34 8		22 8	7½			4 10	9	1 8	15
2			32 4	4½	27 0	6	11 0	6	3 2	9	1 0	12	29 8	4½	34 3		23 4	7½			4 8	9	1 7	15
3			32 6	4½	25 5	6	10 5	6	3 1	9	1 0	12	30 11	4½	33 10		23 10	7½			4 5	9	1 6	15
4			32 7	5	24 2	6	10 0	6	3 0	9	1 0	12	32 11	4½	33 5		24 2	7½			4 2	9	1 6	15
5			32 8	5	22 8	6	9 6	6	2 11	9	1 11	12	33 10	4½	32 11		24 6	7½			4 0	9	1 6	15
6			32 11	5	21 0	6½	9 0	6	2 10	9	0 11	12	34 9	4¾	32 2		24 10	7½			4 0	9	1 5	15
7			32 2	5½	19 6	6½	8 10	6	2 10	9	0 11	12	35 8	4¾	31 5		25 2	7½			3 9	9	1 4	15
8			33 5	4½	18 0	6½	8 9	6	2 9	12	0 10	12	36 6	5¼	30 7		25 4	7½			3 7	9	1 4	15
9			33 8	4½	16 6	6½	8 9	6	2 8	12	0 0	9	37 3	5¼	29 10		25 7	7½			3 5	9	1 4	15
10			33 10	4½	14 0	6½	8 8	6	2 7	12	2 6	9	37 9	5¼	29 0		25 10	7½			3 4	9	1 3	15
11			34 0	4½	12 6	6½	8 4	6	2 6	12	3 3	7½	38 1	3¾	28 2		26 0	7½			3 4	9	1 3	15
12			34 2	5½	10 6	6½	8 0	6	2 6	12	4 3	5¼	38 3	3¾	27 3		26 1	7½			3 2	9	1 2	15
13			34 3	5½	9 0	6½	7 9	6½	2 6	12	7 0	4½	38 4	3¾	26 3		26 2	7½			3 0	9	1 1	15
14			34 4	5½	9 0	6½	7 6	6½	2 5	12	10 2	4½	38 4	3¾	25 8		26 0	7½			2 11	9	1 0	15
15			34 4	5½	9 4	6	7 0	6½	2 4	12	13 3	4½	38 4	3¾	25 1		25 9	7½			2 9	9	0 11	15
16			34 4	5¼	9 7	6	6 0	6½	2 3	12	15 6	4½	38 3	3¾	24 6		25 6	7½			2 7	9	0 11	15
17			34 5	5½	10 2	6	5 8	6½	2 4	12	18 0	4½	38 2	3¾	23 9		25 2	7½			2 7	9	0 10	15
18			34 4	5	11 4	6	5 4	6½	2 3	12	19 6	4½	38 1	3¾	23 0		24 10	7½			2 7	9	0 10	15
19			34 3	5	12 0	6	5 0	7½	2 2	12	21 0	4½	37 11	3¾	22 7		24 6	7½			2 7	9	0 10	15
20			34 2	5	12 6	6	4 9	7½	2 1	12	22 0	4½	37 8	4½	22 1		24 0	9			2 6	9	1 4	12
21			34 0	5	13 0	5¾	4 6	7½	2 0	12	23 6	4½	37 7	4½	21 7		23 6	9			2 6	9	2 6	12
22			33 8	5½	13 6	5½	4 4	7½	1 10	12	24 1	4½	37 5	4½	21 2		23 0	9			2 5	9	3 9	12
23			33 6	5½	14 0	5½	4 2	7½	1 8	12	24 9	4½	37 3	4½	20 11		22 6	9			2 4	9	4 9	7½
24			33 1	5½	14 2	5¼	4 0	7½	1 6	12	25 3	4½	37 0	4½	20 9		21 11	9			2 3	9	5 6	7½
25			32 7	5½	14 3	5¼	3 10	7½	1 5	12	25 9	4	36 9	4½	20 7		21 4	9			2 2	9	6 0	7½
26			32 0	5½	14 4	5¼	3 9	7½	1 4	12	26 3	4	36 6	4½	20 7		20 9	9			2 1	9	6 5	6¾
27			31 3	5¼	14 1	6	3 8	7½	1 3	12	26 11	4	36 3	4½	20 9		20 6	9			2 0	9	6 10	6¾
28			30 4	5¼	13 6	6	3 6	7½	1 3	12	27 3	4	36 0	5¼	20 11		20 0	9			1 11	9	7 3	7½
29			.....	...	13 0	6	3 5	9	1 2	12	27 6	4	35 9	5¼	21 1		19 6	9			1 10	9	7 4	7½
30			.....	...	12 9	6	3 4	9	1 2	12	27 10	4	35 4	5¼	21 6		19 0	9			1 9	9	7 4	7½
31			.....	...	12 6	6	.....	...	1 1	12	.....	...	35 1	5¼	22 1		.....	...			.....	...	7 4	7½

No return for this month.

* These observations were made for the Department of Harbours and Rivers, Sydney, by Mr. J. Moloney.

June, 1873.—The observer says: "The river continues to rise slowly. We are apprehensive of the town of Bourke being inundated."

July, 1873.—The town of Bourke was partially inundated, and many persons compelled to leave their houses, which were surrounded with water. The greater portion of the inhabitants dug trenches and raised dams around their dwellings.

* Observations of the River Darling, made at Bourke, New South Wales, during the year 1874.

Date.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.	
	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.	Height of River on Gauge.	Time taken by float to pass over 300 yards.
	ft. in.	min.	ft. in.	min.	ft. in.	min.			ft. in.	min.			ft. in.	min.	ft. in.	min.								
1	7 3	9	29 0	3¾	32 5	5¼			12 6	8¼			3 0	15	24 9	6								
2	7 2	9	29 3	3¾	32 0	5¼			11 6	8¼			3 1	15	25 6	6								
3	7 1	9	29 6	3¾	31 6	5¼			11 0	8¼			3 2	15	26 0	6								
4	7 0	9	29 9	4½	31 0	5¼			10 6	8¼			3 2	15	26 6	6								
5	7 3	6	30 0	4½	30 6	5¼			10 3	8¼			3 2	15	27 0	6								
6	7 4	6	30 2	4½	30 0	5¼			9 9	8¼			3 2	15	27 5	6								
7	7 5	6	30 5	3¾	29 6	5¼			9 4	8¼			3 3	15	29 9	6								
8	7 4	6	30 10	3¾	28 11	5¼			9 2	8¼			3 4	12	30 0	6								
9	7 2	9	31 1	3¾	28 3	5¼			9 0	9			3 5	12	30 2	6								
10	6 11	9	31 3	3¾	27 8	5¼			8 9	9			3 6	12	29 10	6								
11	6 9	9	31 7	3¾	27 2	5¼			8 6	9			3 6	12	29 5	6								
12	6 3	9	31 10	3¾	26 8	5¼			8 2	9			3 8	12	28 11	6								
13	6 1	9	32 3	3¾	26 4	5¼			7 10	9			3 10	11¼	28 3	6								
14	6 4	9	32 6	5¼	26 0	5¼			7 6	9			4 3	11¼	27 5	6								
15	6 6	9	32 9	5¼	25 9	4½			7 3	9			5 0	11¼	26 4	6								
16	7 3	6	33 0	5¼	25 6	4½	.....	.....	7 0	9	.....	.....	5 10	9	25 3	6	No returns.							
17	8 1	6	33 2	5¼	25 4	4½			6 9	9			6 9	9	24 0	6								
18	8 10	6	33 4	5¼	25 1	4½			6 6	9			7 10	9	23 0	7½								
19	10 10	6	33 5	5¼	24 11	4½			6 4	12			8 11	9	22 7	7½								
20	12 0	6	33 6	5¼	24 7	4½			6 1	12			9 11	7¼	22 7	7½								
21	13 2	5¼	33 6	5¼	24 2	4½			6 0	12			11 0	7¼	22 7	7½								
22	14 4	5¼	33 6	5¼	23 7	5½			5 9	12			12 7	7¼	22 10	7½								
23	15 6	5¼	33 5	5¼	23 1	5¼			5 7	12			14 4	7¼	23 1	8¼								
24	22 0	3¾	33 4	5¼	22 5	5¼			5 6	12			15 9	6	23 4	8¼								
25	26 6	3¾	33 3	5¼	21 8	5¼			5 5	12			17 6	6	23 9	8¼								
26	27 9	3¾	33 1	5¼	21 4	5¼			5 4	12			18 9	6	23 11	8¼								
27	28 0	3¾	32 11	5¼	21 1	5¼			5 3	15			19 9	5¼	24 2	7½								
28	28 3	3¾	32 9	5¼	20 9	5½			5 2	15			20 11	5¼	24 4	7½								
29	28 6	3¾	.....	...	20 6	5¼			5 1	15			22 0	5¼	24 2	7½								
30	28 8	3¾	.....	...	20 3	5¼			5 0	15			23 0	4½	23 10	7½								
31	28 10	3¾	.....	...	20 0	5¼			4 11	15			24 0	4½	23 4	7½								

* These observations were made for the Department of Harbours and Rivers, Sydney, by Mr. J. Moloney.

February.—Weather changeable, atmosphere cool, the hot winds of December last gone. January and the beginning of February hot too. The thermometer over a hundred in the shade for nearly three months in the year.
March.—Weather fine in the early part of the month, and raining the latter portion. Local rain does not much affect the rising of the river here.
July.—Very little rain in the neighbourhood of Bourke. The Barwon, Namoi, and Bogan are high ; heavy rains in those localities, which cause the river to rise here. There was 8 inches of rain at Strathbogie in July, in November 7 inches, and in December 8 inches. So there must have been another rise in the Darling at the end of 1874.—H.C.R.

* Observations of the River Darling, made at Bourke, New South Wales, during the year 1876.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
						ft. in.	ft. in.	ft. in.	ft. in.			
1						..	f.	17 6	27 0			
2						..	..	18 4				
3						..	..	20 6				
4						..	r.	21 6				
5						..	..	23 6				
6						..						
7						..	..	..	f.			
8						..	f.	28 0				
9						..	..	30 6				
10						..	..	32 6				
11						..	r.	33 0				
12						..						
13						..						
14						..	..	35 0	8 0			
15						..	..	..	7 9			
16				No record.		..						
17						..						
18						..	..	..	7 0			
19						..	12 9	..	6 9			
20						..	12 0	..	7 0			
21						..	13 0					
22						..						
23						..			†			
24						..	13 0					
25						..	..	33 0	4 0			
26						..	..	33 0	3 0			
27						1 0	..	..	3 6			
28						f. s.	..	31 6	4 0			
29						..	15 0	..	4 0			
30						..						
31						..	17 0	28 0	..	..	..	

* These observations taken from the daily heights of the river published in the *Argus*.
† River falling slowly. Navigation closed to Bourke.

Observations of the River Darling made at Bourke, New South Wales, during the year 1877.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	ft. in.	ft. in.	ft. in.	ft. in.					ft. in.			
1	..	..	32 0	..								
2	..	..	32 0	21 0								
3	..	..	31 0	21 0								
4	..	..	..	20 0								
5	s. l.	..	27 0	19 0								
6	..	..	25 0	18 0								
7	..	‡0 4½	24 0	..								
8	..	..	21 0	..								
9	..	10 0	19 0	16 0								
10	..	11 0	15 0	15 0								
11	..	..	..	14 0								
12	†	14 6	8 0	13 6								
13	1 0	15 0	6 0	13 6								
14	..	15 6	6 0	12 6								
15	3 6	16 6	5 0	..								
16	..	..	..	11 0	Summer level.			Very low.	Very ow.			
17	4 4	..	..	10 6						Very low.		
18	3 10	..	..	..							Low.	
19	f.	20 6	7 0	9 6								Very low.
20	3in. d.	..	4 6	8 0					r.			
21	..	..	..	8 0					3 0			
22	..	..	5 6	..								
23	..	..	..	6 10								
24	r. s.	23 0§	8 0	..								
25	..	..	..	5 0					f.			
26	..	22 6§	10 0	5 6								
27	f. f.	19 0§	12 0	5 0								
28	..	..	14 0	..								
29	..	..	16 0	..								
30	..	..	..	..								
31	f.	..	17 0	..								

* These observations taken from the daily heights of the river published in the *Argus*.
† Risen 2 feet since yesterday morning, flood coming down.
‡ Risen 2 feet since yesterday morning.
§ These observations made at Brewarrina.

* Observations of the River Darling, made at Bourke, New South Wales, during the year 1878.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	ft. in.	ft. in.	ft. in.	ft. in.				ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
1			12 0	4 0					..	rising	8 0	f. v. f.
2			13 0	3 10					3 6	..	9 6	..
3			..	3 6					..	..	..	..
4			16 0	..					falling	..	..	12 0
5			17 6	3 0					..	22 0	13 0	10 0
6			18 0	2 6					..		12 0	9 0
7			18 0	..					..		14 0	6 6
8			..	2 6					..		14 6	6 0
9			16 0	2 3					..		14 0	..
10			..	..					..		..	..
11			14 0	..					..		12 6	..
12†			13 0	2 0					rising		14 0	2 0
13			..	..					..		14 0	2 0
14			11 0	..					..		14 0	..
15			10 6	..					..		14 0	..
16			11 0	s.l.					falling		14 6	s.l
17			..	..				3 0	..		15 0	..
18			9 0	..				..	..		..	..
19			9 0	..				..	..		..	Low.
20			9 0	..				S.L.	..		16 0	s.l.
21			..	..				..	8 6		18 0	..
22			8 0	..				..	..		..	..
23	v. low		..	..				4 6	rising		19 0	..
24	..		..	..				4 3	..		..	..
25	..		6 3	..				..	..	4 0	19 0	..
26	..	‡ s.l.	5 9	..			r. s.	5 0	..	..	19 0	..
27	..	6 0	..	..			..	8 10	..	..	19 6	..
28	..	9 0	..	..			..	6 12	..	..	falling	..
29	..	..	4 10	..			..	..	..	..	..	..
30	..	..	..	..			..	7 6	..	..	19 2	..
31	..	..	4 6	..			..	6 0	..	7 0	..	..

* These observations taken from the daily hights of the river published in the *Argus*.
† River almost stopped.
‡ Risen to Summer level, and still rising.

Observations of the River Darling, made at Bourke, New South Wales, during the year 1879.

Date.	Jan.	Feb.	Mar.	April	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.
			ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
1			2 0	24 0	21 0	29 3	32 4	29 9	37 3	36 0	37 6	9 0
2			3 2	25 2	22 0	29 4	31 8	29 6	37 8	36 2	37 4	9 2
3			4 2	25 6	22 8	20 7	31 4	29 0	38 3	36 4	37 2	9 0
4			5 3	25 9	24 3	21 3	31 0	28 6	38 8	36 4	37 0	9 0
5			6 3	26 0	25 0	22 0	31 0	28 0	38 10	36 4	36 7	8 9
6			7 3	26 4	25 6	22 5	30 10	27 6	39 0	36 8	36 4	8 6
7			8 0	26 9	25 6	23 3	30 7	27 0	39 0	36 9	36 0	8 4
8			9 2	28 0	27 3	23 9	30 3	26 4	38 10	36 10	35 6	8 2
9			10 0	28 3	28 6	24 6	30 0	25 6	38 9	36 11	35 4	8 2
10			10 0	28 5	29 6	25 3	29 4	25 0	38 8	37 6	35 0	8 0
11			11 3	28 9	29 9	25 9	29 0	24 6	38 6	38 0	34 9	8 0
12			12 2	28 10	30 0	26 6	28 10	24 6	38 4	38 6	33 6	7 10
13			12 4	28 6	30 5	27 6	28 3	24 8	38 0	39 0	33 0	7 9
14			12 6	28 3	30 5	28 4	27 0	24 10	37 8	39 4	32 6	7 8
15			12 9	28 0	30 6	29 0	27 9	25 2	37 0	39 6	32 0	7 8
16			12 10	27 9	30 8	30 2	27 6	25 8	36 9	39 8	31 6	7 0
17			13 0	27 6	30 6	30 6	27 4	27 0	36 4	39 8	28 4	6 6
18			13 2	27 3	30 4	30 9	27 0	28 0	36 4	39 6	27 10	6 0
19			15 6	26 0	30 0	31 0	26 9	29 0	36 0	39 4	25 6	5 9
20			16 6	25 0	29 4	31 2	27 3	30 0	36 0	39 3	22 0	5 3
21			17 6	24 0	28 6	31 4	27 8	30 9	35 8	39 2	21 6	5 2
22			18 0	22 5	27 4	31 8	27 9	31 9	35 4	39 0	18 6	5 2
23			19 0	20 6	26 6	31 10	28 0	32 4	35 3	39 0	17 6	5 0
24			19 4	19 6	25 9	32 0	28 4	33 4	35 0	38 10	17 0	4 9
25			19 8	18 6	24 0	32 1	28 8	34 4	35 0	38 6	16 6	4 6
26			20 0	17 3	23 0	32 2	28 9	34 6	35 3	38 0	13 6	4 4
27			20 3	16 6	21 0	32 3	28 10	35 0	35 6	37 6	12 0	4 0
28			20 8	17 6	20 0	32 4	29 0	35 2	35 8	37 4	10 6	4 0
29			21 0	18 6	19 6	32 8	29 2	35 9	35 10	37 0	9 9	3 10
30			22 0	20 0	19 4	32 6	29 4	36 3	36 0	36 6	9 0	3 8
31			23 0	..	20 2	..	29 6	36 9	..	36 4	..	3 4

Observations of the River Darling made at Bourke, New South Wales, **during the year 1880.**

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.				ft. in.	ft. in.	ft. in.
1	..	..	..	..	..	..				s. l.	..	..
2	3 2	4 0	14 6	19 6	13 4	17 6				..	9 6	3 0
3	..	..	..	..	..	..				..	..	..
4	3 0	3 6	13 0	20 0	12 9	14 0				..	9 4	1 9
5	..	..	..	..	..	..				..	..	..
6	2 8	3 0	11 6	18 6	13 4	12 0				..	9 0	1 0
7	..	..	..	..	..	..				..	..	..
8	2 10	2 10	11 4	17 6	14 0	7 0				..	10 0	S. L.
9	..	..	..	..	..	..				..	..	
10	3 0	1 10	12 0	16 6	15 6	5 6				..	10 8	
11	..	..	..	..	..	..				..	..	
12	3 4	3 6	13 6	15 6	14 4	4 6				..	11 0	
13	..	..	..	..	..	..				..	..	
14	3 8	18 0	14 0	14 6	16 6	4 2				s. l.	11 4	
15	..	..	..	..	..	..				..	..	
16	4 0	20 6	17 0	13 8	20 6	4 0	Summer level.			1 0	11 2	
17	..	..	..	..	..	..				..	..	
18	4 6	23 10	19 0	13 8	24 6	3 0				1 8	10 9	
19	..	..	..	..	..	..				..	..	
20	5 0	20 0	19 6	14 6	25 0	2 10				2 0	10 0	
21	..	..	..	..	..	..				..	..	
22	5 6	17 6	17 0	15 6	24 0	2 0				2 3	9 6	
23	..	..	..	..	..	..				..	..	
24	6 0	15 6	16 0	13 6	23 6	1 6				2 6	8 8	
25	..	..	..	..	..	..				..	..	
26	6 2	15 4	15 10	14 0	23 2	s. l.				3 6	8 0	
27	..	..	..	..	..	..				..	..	
28	5 10	16 0	17 6	14 9	21 0	..				4 8	7 9	
29	..	..	..	..	..	..				..	..	
30	4 8	..	18 6	14 0	19 6	..				5 0	7 6	
31	..	..	..	..	..	..				..	..	

Summer level.

Observations of the River Darling, made at Bourke, New South Wales, during the year 1881.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	ft. in.	ft. in.	ft. in.	ft. in.							ft. in.	
1	..	..	..	..							Summer level.	
2	..	5 9	4 3	..								
3	..	..	..	..								
4	..	7 0	3 0	..								
5	..	..	..	..								
6	..	8 0	2 0	s. l.								
7	..	..	..	..								
8	..	7 9	1 2	2 0								
9	..	..	..	..								
10	..	7 4	0 9	3 0								
11	..	..	..	..								
12	..	6 7	0 6	2 0							s l.	
13	..	..	..	..							..	
14	..	6 0	s. l.	1 9							3 9	
15	..	..	..	..							..	
16	..	5 6	..	s. l.							3 4	
17	..	..									..	
18	..	5 4									2 9	
19	..	..									..	
20	..	5 4									2 0	
21	..	..									..	
22	..	5 4									1 9	
23	..	..									..	
24	s. l.	5 6									1 0	
25	..	..									..	
26	1 0	5 8									s. l.	
27	..	..									..	
28	2 0	5 7									..	
29	..	..									..	
30	3 4	5 4									..	
31	..	..									s. l.	

Summer level.

Summer level.

Summer level.

Observations of the River Darling, made at Bourke, New South Wales, during the year 1882.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.
		ft. in.	ft. in.	ft. in.		ft. in.	ft. in.	ft. in.			ft. in.	ft. in.
1		..	..	..			..	..				..
2		..	26 0	4 9			s. l.	2 0				6 3
3		..	..	..			..	..				..
4		s. l.	25 6	3 0			..	2 9				5 9
5		..	..	..			..	..				..
6		9 0	24 6	1 9			s. l.	3 0				5 0
7		..	..	..			..	..				..
8		11 0	21 6	..			0 6	3 6				4 6
9		..	..				..	..				..
10		14 0	17 0				0 9	4 0				4 0
11		..	..				..	..				..
12		17 0	13 6				1 0	4 3				4 0
13		..	..				..	..				..
14		19 6	11 9				1 3	4 3				4 3
15		..	..				..	..				..
16	..	20 4	11 0		Summer level.	Summer level.	1 3	4 0	Summer level.	Summer level.		4 4
17		..	..				..	..				..
18		21 0	10 4				1 3	3 0				4 6
19		..	..				..	..				..
20		22 0	9 3				1 3	2 6				5 0
21		..	..				..	..				..
22		23 0	8 3				1 0	2 0				5 4
23		..	..				..	..				..
24		24 6	7 6				0 6	1 6			s. l.	6 6
25		..	..				..	..			..	..
26		25 6	7 0				s. l.	1 0			7 0	7 6
27		..	..			..	..	..			..	..
28		26 0	6 0			1 0	..	0 6			7 9	9 0
29		..	..			..	..	..			..	..
30		..	5 6			1 3	0 9	s. l.			7 0	11 0
31		..	..			..	..	..			..	..

Observations of the River Darling, made at Bourke, New South Wales, during the year 1883.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	ft. in.	ft. in.	ft. in.	ft. in.						ft. in.	ft. in.	ft. in.
1	..	..	..	..								..
2	12 3	6 6	12 0	10 0		2 0						2 0
3	..	..	..	..		..						..
4	13 0	7 4	13 0	8 0		1 6						2 4
5	..	..	..	..		..						..
6	13 4	8 0	14 0	6 0		1 9						2 3
7	..	..	..	..		..						..
8	13 9	8 0	15 0	4 6		2 3						1 6
9	..	..	..	..		..						..
10	13 3	7 6	16 0	3 0		1 6						0 6
11	..	..	..	..		..						..
12	11 6	7 0	17 0	1 6		0 6						
13	..	..	..	..		..						
14	10 4	6 0	17 9			0 4				1 6		
15	..	..	..							..		
16	8 0	5 9	18 4							2 9		
17	..	..	..							..		
18	6 6	5 6	18 9							1 6	2 6	
19	..	..	..							..	..	
20	5 9	5 0	19 4							3 6	3 4	
21	..	4 10	..							..	..	
22	5 0	5 0	20 0							3 4	4 6	
23	..	..	..							..	..	
24	6 0	7 0	19 9							2 6	5 0	
25	6 6	..	..							..	..	
26	6 0	9 9	19 0							1 6	4 6	
27	..	..	..							..	..	
28	5 0	10 6	16 4							1 4	3 6	
29	4 6	..	..							..	..	
30	5 0	11 4	13 6							s. l.	2 0	
31	..	..	..							..	..	

Summer level.

Summer level.

Summer level.

Summer level.

Summer level.

Observations of the River Darling, made at Bourke, New South Wales, **during the year 1884.**

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.
		ft. in.	ft. in.					ft. in.	ft. in.			
1			..					s. l.				
2			2 0					..				
3			..					3 0				
4			1 9					..				
5			.					6 0				
6								..				
7								8 0				
8								..				
9								9 0				
10								..				
11								10 0				
12								..				
13								10 8				
14								..				
15								10 0				
16								..				
17								9 6				
18								..				
19								8 0				
20		5 0						..	1 0			
21		..						6 6	..			
22		5 9						..	1 9			
23		..						4 6	..			
24		7 9						..	2 4			
25		..						2 0	..			
26		8 0						..	2 0			
27		..						1 6	..			
28		6 6						..	1 6			
29		..						s. l.	..			
30		..						..	s. l.			
31		..						..	..			

Summer level. Summer level. Summer level. Summer level. Summer level. Summer level.

Observations of the River Darling made at Bourke, New South Wales, during the year 1885.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	ft. in.			ft. in.	ft. in.							
1	..			..	..							
2	..			..	5 0							
3	..			..	..							
4	..			s. l.	4 6							
5	..			..	..							
6	..			1 6	4 0							
7	..			..	..							
8	..			3 0	3 6							
9	..			..	..							
10	..			5 0	4 0							
11	..			..	..							
12	..			6 6	3 9							
13	..			..	..							
14	..			8 0	3 3							
15	..			..	..							
16	..			8 4	3 0							
17	..			..	..							
18	..			7 6	2 6							
19	..			..	..							
20	..			6 6	1 6							
21	..			..	..							
22	s. l.			6 0	0 6							
23	..			..	..							
24	s. l.			5 9	s. l.							
25	..			..	..							
26	2 6			6 3	..							
27	4 0			..	..							
28	..			6 4	..							
29	s. l.			..	..							
30	..			6 0	..							
31	..			..	..							

Summer level.

Summer level.

Observations of the River Darling, made at Bourke, New South Wales, during the year 1886.

Date.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	ft. in.	ft. in.	ft. in.		ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
1			2 2			..	28 4	..	37 5	33 1	25 5	26 0
2			2 0			..	28 0	30 7	37 3	32 8	26 1	
3			1 9			0 10	27 10	30 0	37 2	..	27 9	
4			1 1			0 10	..	29 6	37 1	31 6	28 5	
5			1 5			..	27 6	29 5	..	30 8	29 1	
6						..	27 0	29 0	36 9	29 8	30 0	
7						6 6	26 8	28 6	36 7	28 6	..	
8						8 4	26 6	..	36 5	27 0	31 3	
9						11 0	27 2	29 5	36 3	27 0	32 5	
10						13 0	27 6	29 6	36 6	..	33 0	
11	3 0					14 6	..	30 2	36 7	21 0	33 8	
12	..					16 0	28 6	30 11	..	18 10	34 1	
13	2 9					..	29 0	31 6	36 8	17 8	34 8	
14	4 3					18 0	29 6	32 6	36 10	17 2	..	
15	4 10					19 3	30 0	..	37 0	16 9	35 2	
16	2 2					20 0	30 8	34 4	37 1	16 9	35 3	
17	..					20 9	31 3	34 11	37 3	..	36 4	
18	2 4					21 9	..	35 5	37 3	17 0	35 2	
19	2 1					22 6	32 3	35 5	..	17 3	34 10	
20	1 10					..	32 9	36 1	37 2	17 5	34 4	
21	1 2					24 0	33 3	36 5	37 0	18 3	..	
22	0 10	1 0				24 9	33 8	..	36 10	18 5	34 0	
23	1 3	0 9				25 5	33 7	36 7	36 8	19 2	33 7	
24	..	s. l.				26 3	33 9	36 9	36 4	..	31 0	
25	1 0	2 1				26 9	..	36 11	36 3	20 1	30 0	
26	0 10	2 6			0 6	27 3	33 8	37 3	..	21 1	29 0	
27	0 9	2 7			0 9	..	33 7	37 5	35 3	21 8	27 6	
28	0 9	..			0 6	28 3	33 1	37 5	34 10	22 5	..	
29	0 9	..			0 9	29 3	32 9	..	34 6	23 1	26 0	
30	0 9	..			..	28 0	32 4	37 6	34 0	23 11	27 6	
31	..	..			..	..	31 10	37 6	..	..	..	

River low.

Reminiscences in the interior of New South Wales, from the autumn of 1864 to Christmas 1874, by Wm. J. Conder, then Licensed Surveyor.

Towards the end of April, 1864, I started from the Lachlan River, at the confluence of the Kalingalungaguy Creek, about 30 miles below Condoblin, to explore and survey, if practicable, the then vacant country between that point and the Darling River at Gunderbooka, with a view to pastoral settlement on it by some Melbourne speculators.

The Lachlan was then dry, except a few waterholes here and there. The supply of water in the back country very uncertain; but with the assistance of an aboriginal, a native of that part of the Colony, sufficient for the use of my party was procured. We had to travel from water to water guided by the blackfellow in a very circuitous course. The water was found in almost every instance in small clay pans from 6 inches to a foot in depth, and not much better than a puddle as to quality and quantity. There was good rough feed for the horses. From Mount Marobey, about 60 miles from the start, it was found necessary to return for supplies. I rode back in one day and found the river in a flooded state, but not overflowing its banks to any great extent. I was unable to reach the camp at Marobey in one day with loaded pack horses, and remember the night as one of the coldest I have ever experienced: the hoar frost in the morning looked like snow, it covered everything and was fully $\frac{1}{4}$ inch thick. Soon after this we passed a homestead belonging to Messrs. Peate and Reid, two enterprising young men who were endeavouring to form a station, sinking a well and excavating tanks, &c. They had settled at the place two or three years before and had encountered great hardships for want of water; they had no stock on the place except one or two saddle horses. They rendered me ever possible assistance and the most generous hospitality. With Mr. Peate I rode about for considerable distances from my party exploring the country. On these trips we saw some excellent grazing country slightly undulating, but quite waterless at that time. After this we got into mulga forest country and saw no more mallee and porcupine grass; the herbage was very luxuriant but the water supply still more precarious. Emus bathing in and splashing it about in these small clay pans had reduced it in quantity, and mixed it with mud so as to be unusable. I left the camp at a small watercourse some 80 miles from the Darling, and rode on ahead to the river which was then in a very high flood; it was impossible to travel the usual road along its banks. I struck the river at Gunderbooka, and in going from thence to Nulta Nulta on the opposite bank, just above the junction of the Warrego, I got into serious difficulties by attempting to cross what appeared,

judging from the timber, to be a wide expanse of shallow water, suddenly it deepened, and my horse after swimming for a few yards sank, and came up again behind me in the shallow part and galloped away. I was determined to get through as my destination was only some 5 miles further on. I swam on until I found shallow water again, and walked the remainder of the journey minus boots, which impeded my swimming to such an extent that I had to take advantage of a convenient tree to pull them off and leave them there. Soon afterwards I went back to the camp and brought it into the Darling, where we stayed some six weeks or two months surveying and exploring some 80 miles back from the river towards Coronga Peak and Cobar.

There was little or no perceptible fall in the river water to the time we left about the end of September, 1864. I wanted to see a marked tree on its bank near Clover Creek, below Gunderbooka, but could not get within a mile of it. At about this time the tribe of aboriginals usually occupying the back country, which we had passed through, came into the river, on account of the scarcity of water in their usual haunts. This I found was their usual custom in the summer months and exceptionally dry seasons. There was some sort of agreement or understanding between them and the river tribe, as to certain localities on the river frontage, which they could inhabit on these occasions without molestation. I think the provisions were very vague and depended on the "Vi et armis" more than any other law among them.

Up to this time I had not been out on the Warrego or Paroo. That the Darling waters were 70 miles wide may have been a fact in a sense; that is, the country is intersected by ana branches, lakes, and swamps, all filled with the flood waters, but it was not a continuous sheet of water for anything like that distance. The mails which were carried on horseback at that time are reported to have been conveyed from Oxley's Tableland, some 25 miles from Bourke, into the town by boats. Probably this report should be received "cum grano." There were large sheets of flood water near the Bogan, as much as 50 or 60 miles above its confluence, for I recollect that one of my horses broke away there, and whilst riding after him in 12 or 18 inches of water he kept me dodging about, and I felt my watch jerked out of my pocket, and saw it fall in the muddy water, but before I could pull up I lost the exact spot and was unable to recover the watch.

Very little, if any, rain fell from the end of April, when I left the Lachlan, until the middle of October when I returned there. In the summer of 1866 I was surveying in the pastoral district of Bligh, which was then in such a state for want of feed and water that it was almost impossible to move about at all. For miles around Coonamble and up into the Warrambungle Ranges the live stock perished in enormous numbers. Water could then

be procured in the bed of the Castlereagh River, in very shallow wells in some places, by scraping away the sand only a few inches in depth. There were a few good dams, such as the one at Beanbah, at Nebea, and a few other places. At Coonamble a natural bar at the confluence of Mogmoodine Creek with the river dams up a large and permanent supply of water in the creek, and has the appearance of a large ornamental lake. I do not think this has ever been known to be dry, but I have seen it very much reduced in size and very muddy. The large waterhole at Gungalgina on the Nedgera Creek I have seen dry. In 1868 there were some welcome thunderstorms, but they were very limited in extent. I remember one which started the Castlereagh River running near Belar Creek, but it did not reach far down. At Mundooran, some 30 miles below there were no trace of it. Before this the river was drier than ever known before, according to the testimony of old residents. The blacks used to catch fish (some of very large size), with their hands, the waterholes having dwindled to such small proportions that the fish could not escape.

In 1870 there was a great flood in the river Macquarie. I had an interest then in a small pastoral property just above the junction of the Marthaguy and Merri Merri Creeks; the whole country from thence to the Macquarie was under water for fully three months, and our sheep died from starvation, as only just the tops of the longer grasses were out of water, and the feed remaining on a very few small patches or islands was speedily exhausted. In this locality the Macquarie River waters are diverted from their proper course by enormous quantities of drift wood which in times of flood are piled up in such masses in the main channel as to be available for a causeway. Many thousand tons of timber are jammed together in inextricable confusion, and the water in consequence breaks over the banks and spreads over miles and miles of the flat country and forms new channels. Probably these rafts of timber are still in existence near the Macquarie Marshes.

I was on the Talbragar River at the time of a very heavy flood—I think in the same year 1870, but am not certain; the rainfall appeared to be local but very heavy for some twelve hours previous. I crossed the Denison Town bridge in that flood when the position of the hand-rails could only be known by the ripple, the water being several inches above them. This river passes through undulating country, so there was no great extent of water outside its banks. I followed it from Cobbora to Denison Town at the highest of the flood.

The largest flood I ever witnessed was in the Castlereagh in January, 1874, about 12 miles below Coonabarabran. The water rose with wonderful rapidity. I believe fully 30 feet, still it was in most places confined within its banks. I tried to swim across,

but did not succeed in doing so, the big waves hurled me about anywhere, and I was glad to take advantage of an eddy to get out again almost exhausted. The floods in this river produce great changes, filling up large deep waterholes, which have been used for years for sheep washing, and as favourite resorts for fishing, &c.; whilst in other places new holes are washed out by the accident of some trifling obstruction, such as a fallen tree or otherwise. I once saw an entirely new channel washed out in the Belar Creek, one of the principal feeders of the Castlereagh, which had evidently at some previous time been the main channel, as indicated by the stumps of trees along what had been its banks, exactly similar to the trees growing on the bank of the water-course prior to the flood. I should think this original channel had been filled up long before the discovery of this continent. In my experience of that part of the colony watered by the Lower Macquarie, Castlereagh, and Namoi Rivers, and their tributaries, extending from 1864 to 1875, I found it constantly subject to great extremes, devastating floods, disastrous droughts, or clothed with vegetation of such luxuriance as I have never met with in any other part of the colony. The amount of water which runs away somewhere in the Darling, Macquarie, and Castlereagh Rivers, if some practicable means could be discovered for storing it and using it for purposes of irrigation, would, I think, be ample to fertilize and make an immense tract of country productive to an unprecedented extent.

Discussion.

Mr. Mann remarked that the theory of the cycle of nineteen years, as stated by Mr. Russell, would be greatly modified by the number of cattle in the flood district. The beds of rivers have been filled up and made sandbeds by cattle tracks. Cattle on their way to water invariably make tracks: after heavy rains these tracks become water-courses, and eventually a gully is formed. Immense gorges have thus been cut, and if this is carried on to any great extent it must affect the flooding, as the water is not kept altogether within the original banks of the river but is carried far over the adjacent country. Settlers have reached their land by boats. The next year the river on which they sailed has been filled up with sand, and the following year even the vessels have been covered up.

Mr. Charles Moore said that the fact of finding grass at the bottom of a recent river-bed is not an indication that water has not been there for some time. Fifteen months ago he sent a collector to Bourke to obtain specimens of grasses, &c. He said on his return that the ground was bare, all he could see was a few trees. About five weeks ago he was again sent and brought back

a splendid collection of plants, not only annuals, but perennials of the pea tribe ; they existed there, although there was no appearance of them on the surface. He proposed to read a paper on the existence of these plants at a future date. How they existed was beyond his apprehension, because they have had this drought for several years ; the roots are still alive in the ground. Immediately the flood ceases the plants spring up ; the water does not remain long enough to kill the roots, and as soon as the water clears off the grass and plants grow again.

Mr. Russell, in reply to Mr. Donkin, said that the present flood in the river Darling would probably be sufficient for navigation to the end of the year, because the country had been well soaked with rain and the springs were flowing , and, moreover, there had been recent rains at the heads of the river which had not time to find their way down yet. The river must rise about 4 feet above what is called "summer level" to permit navigation. Sometimes the rise after rain is very rapid. The Darling, at Bourke, rose in February, 1882, 10 feet in the first day, and 10 feet more in the next five days ; and in January, 1885, the Darling, at Wilcannia, rose 28 feet in four days from local rains only. Such sudden floods are down again in a few weeks, unless the rain has extended over a wide area ; then the water with occasional rains may be sufficient to keep up the navigation for months. For instance, the February, 1882 rain was general over the Darling watershed, and took two months to drain off, although there was little or no rain during the two months.

[Diagram.]

RIVER DARLING FLOODS.

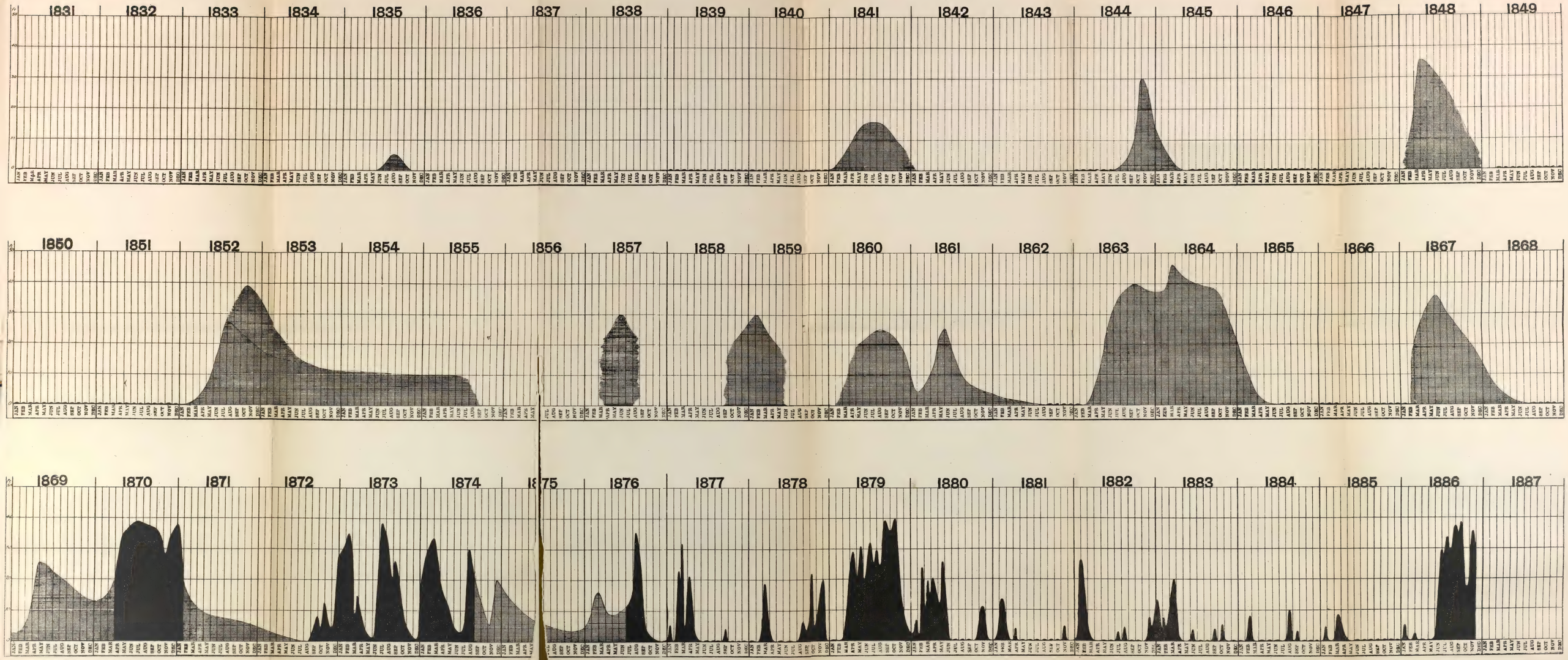


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PHOTO-LITHOGRAPHED AT THE GOVT. PRINTING OFFICE,
SYDNEY, NEW SOUTH WALES.

Diagram for Mr Russell's paper on River Darling Floods

Notes on the Sweet Principle of Smilax Glycyphylla.

By Edward H. Rennie, M.A., D.Sc., Professor of Chemistry in the University of Adelaide.

[*Read before the Royal Society of N.S.W., 3 November, 1886.*]

The Australian sarsaparilla (Smilax Glycyphylla), a climbing plant which grows abundantly on the shores of Port Jackson, is familiar to many inhabitants of the Colony, on account of the peculiar taste of its leaves, somewhat resembling that of liquorice. An infusion of the leaves, supposed to have some efficacy as a blood-purifier, is frequently sold under the name of sarsaparilla. Some time ago, a partial description of a crystalline substance extracted from the leaves was published by Dr. C. R. Alder Wright, and the author, in the Journal of the Chemical Society of London. During the past eight or nine months the examination of this substance has been resumed by the writer.

Some 75 to 80 lbs. of the leaves and stems were macerated with alcohol, the alcohol distilled off, and the syrupy residue repeatedly extracted with ether. On distilling off the ether a crystalline substance remained, which was purified by several crystallizations from hot water, and finally by treatment with acetate of lead, filtering off the precipitate which formed, and passing sulphuretted hydrogen through the warm filtrate. On filtering off the sulphide of lead from the still warm liquid, a colourless solution was obtained which on cooling deposited a mass of slender, perfectly white needles. The substance so prepared is very sparingly soluble in cold water, readily soluble in hot water, very soluble in alcohol, insoluble in chloroform, benzene, and light petroleum. It does not reduce Fehling's solution, but when boiled for a short time with dilute sulphuric acid, a copious white crystalline precipitate is formed; and when this is filtered off, the filtrate reduces Fehling's solution readily.

When crystallized from aqueous ether, it contains 3 molecules of water of crystallization; when crystallized from water, $4\frac{1}{2}$ molecules. Analysis of the anhydrous substance leads to the formula $C_{21}H_{24}O_9$. The substance above alluded to as precipitated on boiling with dilute sulphuric acid has the composition $C_{15}H_{14}O_5$, and in fact appears to be identical with *phloretin*, a substance

obtained from phlorizin (extracted from the root-bark of the apple-tree) by similar treatment. On boiling with strong caustic potash, it splits up into phloroglucol and phloretic acid. Both of these substances were identified by their reactions and analyses.

The filtrate from the phloretin, on neutralization by barium, carbonate, filtration, and evaporation, yields a crystalline substance which when purified has a strong sweet taste, and has the composition $C_6H_{14}O_6$. It is, in fact, isodulcite, a substance which has lately been recognized as a decomposition product of several so-called glucosides.

Obviously, the sweet principle extracted as above from Smilax Glycyphylla is closely related to phlorizin, the latter according to those who have examined it, yielding phloretin and a sugar resembling glucose. The nature of the relationship remains for the present undetermined; but I am endeavouring to obtain a supply of phlorizin, in order to attempt the determination of this point.

Notes on the Theory of Dissociation of Gases.

By R. Threlfall, B.A., Professor of Physics in the University of Sydney.

[*Read before the Royal Society of N.S.W., 1 December, 1886.*]

That gases are essentially discontinuous may be considered as demonstrated by the experiments of Osborne Reynolds. Most gases expand by the same amount as the temperature rises, but there are some that do not, and among the best known of these are nitrogen tetroxide and the vapour of acetic acid. In order to explain this abnormality two hypotheses have been advanced, one, that the gases in the cases cited are decomposed by a rise of temperature, and one, of a purely negative character, that the abnormal expansion is to be traced to the supposed fact that the transition from liquid to vapour is partially continuous over a finite range of temperature. In order to compare these views I propose to adopt the following method of discussing the matter. Assuming a molecular theory of any kind, whether of the vortex atom, or of the ordinary kinetic type, the temperature must be identified as the mean value of the molecular kinetic energy of translation. If the mean mass of a molecule remains constant as is generally assumed, then the velocity must increase, as the temperature rises—since $\frac{1}{2}mv^2$ increases. But the pressure is supposed to be the expression of the loss of molecular momentum per second against the sides of the containing vessel. If the temperature rises as the pressure remains constant, we have to satisfy the condition of increasing kinetic energy, and constant loss of momentum per unit area of containing surface. If the mean mass remains constant then the number of collisions with the sides of the vessel must vary inversely as the mean velocity of the molecules; in other words, the mean free path must increase, and we have the phenomenon of expansion. Since in most gases the expansion is the same per degree of temperature, the increase of the mean free path must be the same. In gases which expand abnormally, therefore, either the increase of mean free path must be in excess of the normal, or the number of molecules in the field must increase. But this increase in the number of molecules involves a breaking up of those previously existing, and hence a change of potential energy, while an increased free path would occur together with a rise in velocity, if mass be

constant; and so in either case heat might be absorbed to an abnormal degree. In ordinary language heat would be absorbed either to produce chemical change or to accomplish external work. But the ratio of the work spent in internal, to that employed in external molecular work probably depends on the complexity of the molecule, so that if no dissociation takes place, either the ratio must diminish—*i.e.*, less energy be used up internally—or the observed large absorption of energy must fail to produce any observable change in the molecule. Both these hypotheses seem improbable, and, therefore, one is forced back on the theory of dissociation *d priori*. It is with respect to the proof of this theory that I desire first of all to speak. Berthelot's theory of an indefinite boiling point marches straight through every dynamical proposition connected with the theory of gases, and overturns amongst other things the fundamentally important law of Adagadro.

The theory of dissociation assumes the decomposition of the molecules of a gas, whether this change is capable of chemical observation or not. As an example of a substance giving rise by its dissociation to products chemically distinguishable we may take steam or the vapour of ammonium chloride examined by Pebal. In order, however, to raise the theory to the rank of a demonstration, we still require a proof that the chemical change observed, accounts for all the change of volume. As far as I know this has never yet been accomplished; it might be done, however, in the following way: Let A B be a tube divided into two compartments by a diaphragm of porous earthenware placed at C. The part A C is connected with a continually working air pump, whereby the pressure in that portion is kept negligably small compared with the pressure in B C. A dissociable gas such as steam is introduced into C B, and by a suitable arrangement is kept at a constant pressure whatever the temperature. Let the temperature of B C be gradually raised. Now when steam dissociates it forms oxygen and hydrogen, and as these diffuse through the plate at C, into what is practically a vacuum at a low temperature the amount of recombination will be small, and may be considered a constant fraction of the whole amount of gas coming through. But the amount of gas coming through will be proportional to the amount dissociated in C B.

We require, therefore, to make a series of experiments at different temperatures in which the quantity of hydrogen or oxygen diffused through the plate per unit time is measured by the ordinary processes of gas analysis.

From other experiments—simple in theory—but difficult in

practice, the co-efficient of expansion of steam is to be measured at these temperatures ; and the excess above the normal value of the co-efficients of expansion of the more permanent gases is to be compared with the amount of dissociation at each temperature. If the two variables are plotted together, the curve would be a straight line if the hypothesis of dissociation is correct, and this would moreover require to pass through the origin of co-ordinates. To settle the question of the origin, a separate experiment would have to be made at some selected temperature. We should have to compare the diffusion from dissociated steam, with the diffusion from pure oxygen or hydrogen under similar conditions. We therefore, require three separate experiments to place the theory of dissociation on a physical basis, even for a gas, which by its dissociation gives rise to components capable of discrimination by chemical analysis. In the case of gases like nitrogen tetroxide, however, where the supposed change is simply molecular, we are unable to apply any analytical process, and so far the theory must for them remain a simple hypothesis. The ordinarily given formulæ for nitrogen tetroxide and acetic acid are $N_2 O_4$ and $C_2 H_4 O_2$ respectively ; but the vapour densities of these gases do not conform to this statement, for the former at high, and for the latter at low temperatures. This is explained by supposing that dissociation takes place. According to the view of Clausius and Williamson, and of chemists generally—and those conversant with the vortex atom theory in particular—a gas is not a simple thing consisting entirely of molecules of one sort. Vapour density processes give us the mean molecular weights, that is they will always give us the same result, supposing there are as many molecules more complex on the one hand, as there are molecules more simple on the other, than the average molecules. Clifford, long ago, pointed out that our diffusion experiments only point to a similarity between molecule and molecule within certain limits and we may add that such experiments would not tell us whether a gas was dissociated or not supposing the products of dissociation to be chemically indistinguishable. Now although in the case of steam and ammonium chloride vapour we have a proof based on analysis that dissociation really does take place, we have as yet no experiments of the type described for proving that the anomalous expansion of these bodies is entirely accounted for by dissociation. In the case of acetic acid and nitrogen tetroxide, however, though we have from the nature of the case no proof from analysis that dissociation really does take place at all, still we have a set of experiments of a kind analogous to those described for steam, tending, as I think, to render the hypothesis of dissociation very probable. Berthelot and Orgier have recently measured the quantities of heat absorbed per degree of temperature at different temperatures for acetic acid vapour, and nitrogen

tetroxide. This most valuable research is published in "Annales de Chemie et de Physique," for 1883, and with it the remainder of what I have to say will deal.

The specific heats of these gases at different temperatures and constant pressures are enormously great, seventy or eighty times as great in some cases as the heats of the permanent gases. Now I find by comparing the corrected results of Berthelot and Orgier for these gases that the heat absorbed over and above the heat taken by a normal gas, over a given range of temperature is practically proportional everywhere to the abnormality of the expansion. If dissociation occurs we should, of course, expect this thermal change. The curves will show how very closely the corrected temperative co-efficients of specific heat and expansion run together. The evidence in favour of the hypothesis of dissociation is therefore very strong, though of course, the diagram might simply point to the absorption of heat requisite for the assumed increased free path on the alternative hypothesis; but against this theory there are several objections. First, the increase of energy seems enormously too great for the increase of molecular kinetic energy of translation. This being the case we must assume that the well known though undetermined co-efficient for the ratio of external to internal molecular work is a function of the temperature. In other words, the internal increase of energy must on the theory be very great; and this ought to be chemically discoverable. But the dissociation theory merely assumes a molecular change of a particular kind, and therefore the distinction between the theories is small when we come to consider them dynamically.

There is another point in connection with this matter which seems to me to be of interest, and that is the fact that Regnault discovered that the temperature co-efficient of the specific heats of gases depends on their chemical nature. Thus simple gases, and compound gases formed from their elements without condensation have no temperature co-efficients at all, as far as the specific heats go. That is the specific heats are independent of the temperature. But with gases formed like steam with a condensation of one-third the original volume, Regnault found temperature co-efficients—not large—compared with the co-efficients found by Berthelot and Orgier, for nitrogen tetroxide and acetic acid vapour. The co-efficients are, of course, functions of the temperature where dissociation goes on, and will rise to a maximum and then diminish when measured over a temperature range embracing one definite chemical change. Regnault did not attain very high temperatures—not high enough to observe this dependence supposing it to exist in the gases he examined. The meaning is however clear. If we assume the variation of specific heat as observed by Berthelot and Orgier to be the

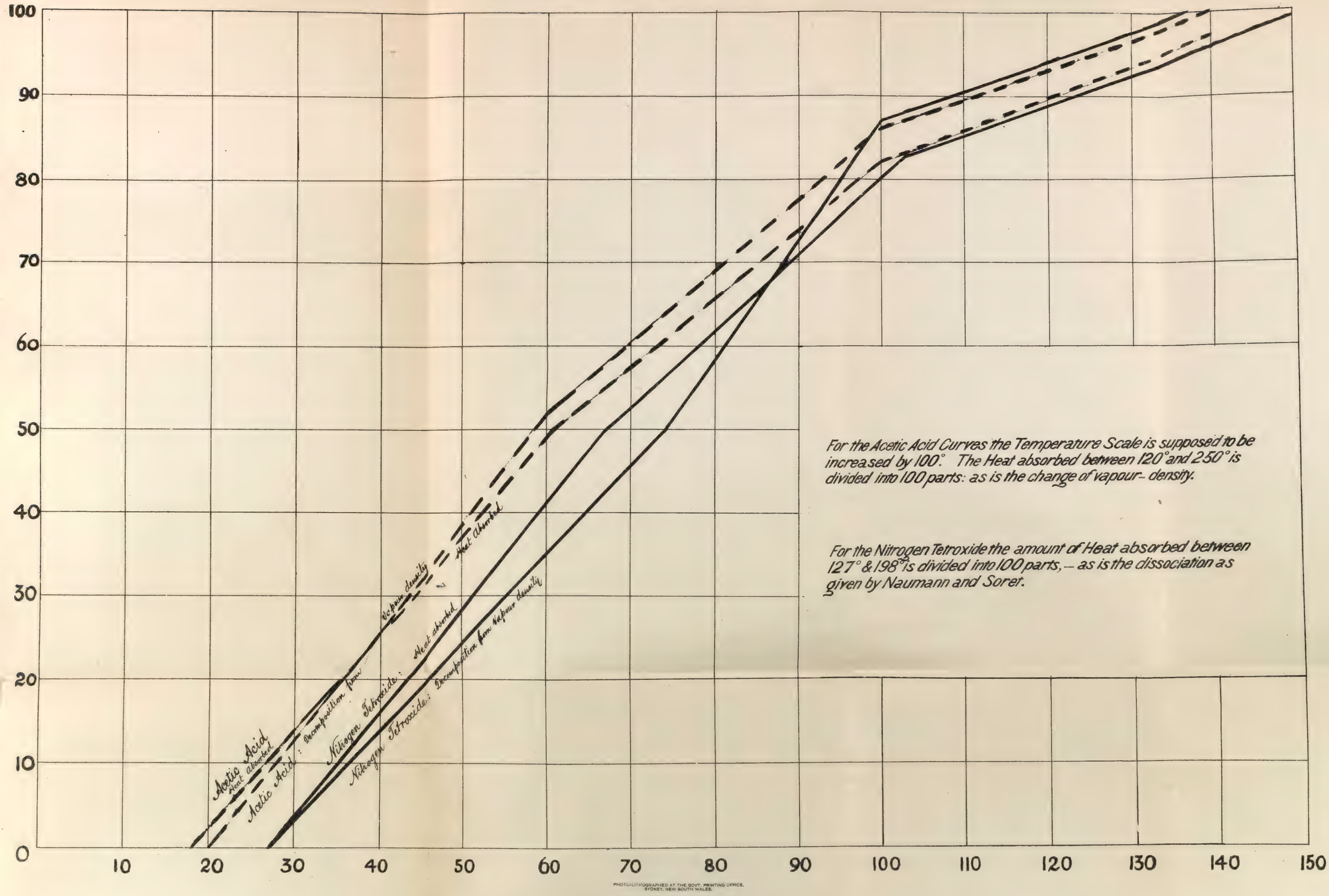
expression of the dissociation taking place, we ought to extend similar reasoning to the cases examined by Regnault. In other words, we ought to admit that gases formed with condensation may undergo a measurable dissociation, though it may not be appreciable by the rough processes of vapour density experiments. To take the case of a gas like nitrous oxide, for instance, Regnault's experiments, as interpreted by Berthelot and Orgier, point either to a small dissociation into the elements oxygen and nitrogen, or to a resolution of N_2O_4 molecules into NO_2 molecules—or both. These gases therefore form a connecting link between the very dissociable gases examined by Berthelot and Orgier, and gases whose dissociation like that of hydrogen or oxygen is too small to be appreciable.

Mr. H. C. Russell, in proposing a vote of thanks to Professor Threlfall, said: That the Professor had taken up a subject which is of the utmost importance to all scientific men, quite as much to the astronomer as to the physicist. Any advance in such knowledge is a contribution to our general knowledge, and at the same time helped directly in several difficult investigations tending to the increase of our knowledge of the sun. He thought it possible to take a view other than that favoured by Professor Threlfall as to the rate of expansion of the gases referred to. We know very little of the condition of the gases we find in nature. It had occurred to him as feasible that gases are subject to such variations of their component parts as are known in regard to matter; as sulphur which possesses different conditions according to the state in which it is at the time-being.

Professor Threlfall, in reply, stated that he considered that the more correct way to proceed would be first to obtain reliable information as to gases, and afterwards apply the knowledge thus gained to solids and not *vice versâ*.

[One Diagram.]

"Diagram to accompany" Notes on the Theory of Dissociation of Gases
By Professor Threlfall
Read before Royal Society of N.S.W. Dec^r 1^st 1886



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Results of the Observations of Comets Fabry, Barnard, and Brooks (No. 1), 1886, at Windsor, New South Wales.

By John Tebbutt, F.R.A.S., &c.

[*Read before the Royal Society of N.S.W., 1 December, 1886.*]

I have much pleasure in communicating to the Royal Society the results of my observations of the comets above mentioned. My Grubb equatorial refractor of 8 inches aperture, not being adapted for the work of observation at the time of the appearance of these comets, I was obliged to have recourse to the Cooke 4½-inch equatorial. Owing to the limited aperture of this instrument, I was unable to follow them for any great length of time.

Comet Fabry.

This comet was discovered by M. Fabry, a student at the Paris Observatory, on the 1st day of December, 1885. It was described on that date as a faint telescopic object, with a nucleus. A notification of the discovery was received at Windsor from the Melbourne Observatory, our central station for astronomical telegraphic announcements, on December 8th, but the comet was unfavorably placed for observation in the southern hemisphere. It was, however, observed from many stations north of the equator. When a sufficient number of observations had been obtained for the calculation of the orbit, it became evident that the faint object of December 1st would, towards the close of April, have an apparent brilliancy several hundred times greater, and would therefore become a conspicuous object to the unassisted eye. It was announced in the Colonial daily newspapers that the comet would be well seen in the western evening sky in the beginning of May. So little, however, is the interest taken in predicted celestial phenomena in New South Wales that the comet, when it did appear in the west, took people generally by surprise. The comet was first observed at Windsor on May 2, and subsequently on May 3, 4, 6, 7, 8, 10, 11, 12, 13, 14, 20, 21, 22, 23, 26, 30, 31, and June 1, 5, 7. On the first five dates the measures were obtained with an excellent position and distance filar micrometer properly oriented. In this way transits of the comet and comparison stars were

observed across a single position thread of the micrometer, while differences of declination were obtained by means of the distance threads in the usual way. The comet subsequently becoming fainter, and there being no means of illuminating the threads in a dark field, I was obliged to have recourse to a square bar-micrometer. This micrometer is the work of Messrs. Cooke and Sons, of York, the makers of the telescope itself. It is similar in its construction to that designed by Mr. Graham, and employed by him in forming the extensive Markree Catalogue of Ecliptic Stars. The only addition to his design is that of two threads stretched across the opposite angles of the square. These were so placed by the makers at my suggestion. One of these threads, invariably adopted as the declination thread, serves as a ready means for orienting the micrometer. The adjustment is effected by so placing the micrometer in the tube of the telescope that while the telescope remains fixed, a star not too far from the equator shall travel accurately along the thread during its whole path through the field of view. This adjustment is made at a great altitude, so that the star's path may not be sensibly affected by refraction, and it is always verified at the time of the comet observations. It was found, however, that, owing to errors in the form of the square, the differential right ascensions of objects were sensibly affected. A careful series of observations were therefore made expressly to determine the corrections due to inaccuracy of form, and a table was constructed giving these corrections, the arguments being the distances of the object north or south of the declination thread. These corrections have been allowed for in all the differential right ascensions, but no sensible error arises in the results for differential declination. I may add, from my own experience, that when a square bar-micrometer is treated in the way I have described, its results are superior to those derived from the ordinary ring. The differential measures of the comet are corrected where necessary for proper motion, and also for refraction, when it is likely to be sensible. The resulting places of the comet, uncorrected for parallax, are exhibited in one of the accompanying tables.

Comet Barnard.

Two days after the discovery of Fabry's comet Mr. Barnard, of Nashville, U.S., detected another faint comet near the Equator. After a few positions were obtained, it was found that this comet would also approach the earth so as to become visible, without a telescope, towards the close of May. The telegram which announced Fabry's comet to the Australian Observatories also brought news of this second discovery. Ample time was, therefore, afforded for the preparations for observation. On May 30th the comet came sufficiently south to be picked up in the bright

band of sky along the western horizon. The observations on that evening at Windsor are, however, not available, as the readings of the equatorial circles were not sufficiently satisfactory to enable me to identify the star of comparison, which was a very small one. Notwithstanding the frequently clouded state of the sky, comparisons were obtained with the square bar-micrometer on May 31, June 3, 10, 11, 13, 27, 29, and July 1. The results are given at the close of the paper.

Comet Brooks (No. 1).

This comet was discovered by Brooks at Phelps, New York, on April 27th. It was detected at Windsor on July 3rd, with the aid of a telegram from the Government Astronomer at Melbourne. It was observed with considerable difficulty on July 3, 4, 11, 12, and 21, by means of the square bar-micrometer already described. The results of the Windsor observations are also given at the close of this paper.

The Reduction of the Star Places, &c.

In the determination of the mean places of the comparison stars I have availed myself of every authority in my Observatory library. In those cases where the stars are found in Stone's Cape Catalogue for 1880 the precessions have been deduced from that catalogue for the middle epoch between the date of such authority and the date of the comet observations. In all other cases the precessions have been determined for the mean epoch by means of Peter's elements. Proper motion has been applied to the place of the Fabry star (No. 10) only. In some few cases the comparison stars could not be identified, so that they will have to be observed in the meridian in order to render the comet places available. The reduction of the star places, and the calculation of the parallax factors have been effected in duplicate by different forms, so as to avoid both systematic and accidental errors; and, I may add, that in the whole work of reduction I have been ably assisted by Miss M. Arnold, a pupil teacher attached to the local Public school. Her merits as a quick and accurate computer have been well tested.

Resulting Places of Fabry's Comet, 1886.

Date.	Windsor Mean Time.	Comet—Star. △ R.A.	Comet—Star. △ N.P.D.	No. of Comps.	Concluded Apparent Places of Comet. R.A.	Concluded Apparent Places of Comet. N.P.D.	Parallax Factors. Log. $\frac{p}{P}$	Parallax Factors. Log. $\frac{\varrho}{P}$	Reductions of Star Places. R.N.	Reductions of Star Places. N.P.D.	Comp. Star.
1886.	h. m. s.	m. s.	′ ″		h. m. s.	° ′ ″	+	+	s.	″	
May 2	6 57 17	+0 57·22	+ 6 52·3	3	4 23 5·13	88 30 48·8	8·7366	9·7438	−0·56	+12·2	1
,, 3	6 41 1	+2 33·42	+ 7 18·8	10	4 47 20·29	94 11 15·3	8·7179	9·7224	−0·56	+13·6	2
,, 4	6 47 26	+3 50·15	+12 41·2	6	....	....	8·7131	9·6887	−0·55	+15·0	3
,, 6	6 25 49	+0 24·53	+ 5 50·1	10	5 49 50·82	107 53 47·9	8·6695	9·5682	−0 50	+17·9	4
,, 6	6 45 20	+0 38·79	+ 8 44·6	3	5 50 5·08	107 56 42·4	8·6948	9·5881	−0·50	+17·9	4
,, 6	6 45 29	−1 0·48	+ 2 28·4	3	5 50 5·28	107 56 38·1	8·6948	9·5881	−0 49	+18·0	5
,, 6	7 9 31	−0 42·57	+ 6 4·1	3	5 50 23·19	108 0 13·8	8·7201	9·6130	−0·49	+18·0	5
,, 6	7 9 31	−2 9·34	− 4 12·7	3	5 50 23·10	108 0 13·1	8·7201	9·6130	−0-49	+18·1	6
,, 7	7 24 0	−1 9·12	+ 3 21·1	10	6 7 27·30	111 17 47·9	8·7303	9·5814	−0·46	+19·1	7
,, 7	8 5 59	−0 41·49	− 8 25·3	10	6 7 54·93	111 22 52·1	8·7601	9·6356	−0·46	+19·1	7
,, 8	7 53 3	+6 44·15	−12 10·1	10	6 22 48·76	114 3 8·1	8·7537	9·5789	−0·47	+19·8	8
,, 8	7 53 3	+2 9·39	+ 0 1·2	10	....	....	8·7537	8·5789	−0·44	+20·0	9
,, 10	7 19 45	+3 43·44	+ 0 45·0	10	6 47 49·90	118 6 20·0	8·7184	9·4256	−0·38	+21·4	10
,, 10	7 19 45	−1 11·24	−17 8·4	10	6 47 50·04	118 6 19·1	8·7184	9·4256	−0·35	+21·6	11
,, 11	7 0 2	+3 4·18	+ 5 33·2	6	6 58 20·79	119 38 39·8	8·6868	9·3232	−0·34	+21·9	12
,, 11	7 0 2	−4 20·79	+16 32·9	6	6 58 20·42	119 38 40·6	8·6868	9·3232	−0·28	+22·1	13
,, 11	8 1 27	+3 29·39	− 9 8·7	5	6 58 45·91	119 42 15·3	8·7625	9·4801	−0·34	+21·9	12
,, 11	8 1 27	+1 49·91	− 7 57·1	5	6 58 45·85	119 42 19·0	8·7626	9·4801	−0·33	+22·0	14
,, 12	6 45 38	+0 7·76	+18 33·6	6	7 7 48·12	120 56 49·5	8·6573	9·2205	−0·28	+22·4	15
,, 12	6 45 38	−1 35·86	+ 3 8·2	6	7 7 47·91	120 56 49·8	8·6573	9·2205	−0·27	+22·5	16
,, 12	6 45 38	−4 44·92	+14 53·1	6	7 7 47·67	120 56 48·5	8·6573	9·2205	−0·25	+22·6	17
,, 12	7 43 45	−1 14·47	+ 5 59·7	14	7 8 9·30	120 59 41·3	8·7448	9·3039	−0·27	+22·5	16
,, 13	7 2 17	−0 3·66	−11 48·4	12	7 16 27·05	122 4 22·9	8·6844	9·2236	−0·25	+22·9	18
,, 13	7 2 17	−2 43·94	+ 5 6·0	12	7 16 27·16	122 4 22·7	8·6844	9·2236	−0·23	+22·9	19
,, 13	8 39 8	−2 12·66	+ 9 14·4	2	7 16 59·01	122 8 31·1	8·7945	9·5138	−0·23	+22·9	19
,, 14	7 51 41	−5 30·46	−10 14·1	7	7 24 24·67	123 3 13·3	8·7541	9·3549	−0·18	+23·3	20
,, 14	7 51 41	−7 7·39	− 5 43·2	7	7 24 24·43	123 3 5·4	8·7541	9·3549	−0·17	+23·4	21
,, 20	6 53 2	+3 30·43	− 5 16·0	10	7 57 55·75	126 37 23·5	8·6635	8·8496	−0·12	+23·9	22
,, 20	6 53 2	+0 2·24	− 6 56·0	10	7 57 56·95	126 37 27·6	8·6635	8·8496	−0·09	+24·0	23
,, 21	7 6 22	+4 44·61	+ 2 32·9	7	8 2 11·71	127 0 59·0	8·6919	8·9260	−0·12	+23·9	24
,, 21	7 6 22	+4 16·81	+16 34·9	7	8 2 11·50	127 0 58·3	8·6919	8·9260	−0·11	+23·8	23
,, 21	7 6 22	−4 37·48	+ 3 20·1	7	8 2 11·54	127 0 58·3	8·6919	8·9260	−0·04	+24·1	25
,, 22	8 9 50	+1 49·33	+ 1 33·4	8	8 6 16·10	127 22 53·6	8·7860	9·2807	−0·08	+24·0	26
,, 22	8 9 50	−2 24·37	−12 26·3	8	8 6 16·29	127 22 50·9	8·7860	9·2807	−0·05	+24·1	27
,, 23	6 31 23	+5 14·46	−19 22·8	4	8 9 41·21	127 40 42·8	8·6188	8·3037	−0·10	−23·8	26
,, 23	6 31 23	+1 0·74	+ 5 23·6	4	8 9 41·39	127 40 40·7	8·6188	8·3037	−0·06	+24·0	27
,, 23	7 3 18	+1 4·84	+ 5 47·4	6	8 9 45·49	127 41 4·5	8·6905	8·8498	−0·06	+24·0	27
,, 26	8 48 38	−2 23·16	−10 47·7	6	8 19 43·54	128 30 44·5	8·8276	9·4202	−0·01	+24·1	28
,, 30	8 23 27	+2 32·33	−13 22·2	10	8 30 31·65	129 21 2·4	8·8176	9·3250	−0·03	−23·8	29
,, 30	8 23 27	+0 32·00	+ 0 17·3	10	....	....	8·8176	9·3250	−0·01	+23·8	30
,, 31	8 3 0	+1 54·88	− 3 18·8	10	8 32 55·75	129 31 48·7	8·8010	9·2308	−0·02	+23·8	31
,, 31	8 3 0	−0 16·30	−13 36·7	10	8 32 56·06	129 31 49·9	8·8010	9·2308	−0·01	+23·9	32
June 1	7 48 7	+2 2·02	− 3 18·4	12	8 35 14·37	129 42 8·0	8·7873	9·1507	−0·02	+23·7	32
,, 1	7 48 7	−0 54·02	− 9 47·7	12	8 35 14·22	129 42 11·2	8·7873	9·1507	0·00	+23·8	33
,, 5	7 35 27	−3 52·27	−13 48·8	10	8 43 50·07	130 20 4·6	8·7846	9·0898	+0·03	+23·6	34
,, 5	7 35 27	−4 37·91	−13 32·1	10	8 43 50·04	130 20 4·6	8·7846	9·0898	+0·04	−23·6	35
,, 7	7 4 17	+0 2·91	+ 3 31·7	10	8 47 45·22	130 37 24·8	8·7477	8·8294	0·00	+23·3	34
,, 7	9 54 54	+0 16·34	+ 4 26·0	7	8 47 58·65	130 38 19·1	8·8643	9·6451	0·00	+23·3	34

Resulting Places of Barnard's Comet, 1886.

Date.	Windsor Mean Time.	Comet—Star.		No. of Comps.	Concluded Apparent Places of Comet.		Parallax Factors.		Reductions of Star Places.		Comp. Star.
		Δ R.A.	Δ N.P.D.		R.A.	N.P.D.	Log. $\frac{p}{P}$	Log. $\frac{q}{P}$	R.A.	N.P.D.	
1886.	h. m. s.	m. s.	′ ″		h. m. s.	° ′ ″	+	+	s.	″	
May 31	6 26 47	+ 2 32·28	− 0 39·0	3	4 54 55·29	113 12 36.5	8·7814	9·7124	− 0·82	+ 10·0	1
,, 31	6 26 47	− 3 0·82	− 14 47·7	3	4 54 54·55	113 12 30·9	8·7814	9·7124	− 0·81	+ 10·4	2
June 3	6 29 1	− 3 23·85	− 18 38·8	4	5 32 12·08	122 22 56·0	8·8172	9·6566	− 0·97	+ 12·5	3
,, 10	7 56 33	+ 1 53·36	+ 10 59·6	8	.....	.....	8·8883	9·6591	− 1·08	+ 16·5	4
,, 10	7 56 52	− 1 27·91	+ 3 7·7	7	.....	.....	8·8882	9·6598	− 1·06	+ 16·8	5
,, 11	7 20 58	+ 8 25·96	+ 0 19·8	8	6 55 3·00	135 19 33·0	8·8970	9·5401	− 1·12	+ 16·5	6
,, 11	7 20 58	− 0 48·95	+ 15 1·7	8	6 55 2·70	135 19 32·2	8·8970	9·5401	− 1·05	+ 17·2	7
,, 13	6 38 26	− 0 26·67	+ 15 53·3	10	7 11 1·95	136 55 12·3	8·8920	9·3063	− 1·03	+ 17·9	8
,, 13	7 22 26	+ 0 11·12	+ 1 26·9	5	.....	.....	8·9086	9·5002	− 1·04	+ 17·9	9
,, 13	7 22 26	− 2 55·55	+ 8 39·7	5	7 11 16·68	136 56 30·7	8·9086	9·5002	− 1·01	+ 18·1	10
,, 27	9 18 26	+ 6 52·15	− 17 5·7	3	8 30 7·66	142 9 10·6	8·9362	9·7297	− 0·83	+ 19·7	11
,, 27	9 18 26	+ 6 19·51	− 10 36·8	3	8 30 7·61	142 9 19·4	8·9362	9·7297	− 0·81	+ 19·7	12
,, 29	7 54 11	+ 0 47·95	− 0 59·8	2	8 37 48·91	142 30 23·4	8·9596	9·4694	− 0·72	+ 20·1	13
July 1	7 54 54	+ 8 2·61	− 10 44·5	8	8 45 11·54	142 50 7·4	8·9631	9·4704	− 0·75	+ 19·5	14
,, 1	7 54 54	+ 8 9·30	+ 13 9·3	8	8 45 11·24	142 50 8·9	8·9631	9·4704	− 0·75	+ 19·5	15

Resulting Places of Brooks' Comet (No. 1), 1886.

Date.	Windsor Mean Time.	Comet - Star.		No. of Comps.	Concluded Apparent Places of Comet.		Parallax Factors.		Reductions of Star Places.		Comp. Star.
		Δ R.A.	Δ N.P.D.		R.A.	N.P.D.	Log. $\frac{p}{P}$	Log. $\frac{q}{P}$	R.A.	N.P.D.	
1886.	h. m. s.	m. s.	′ ″		h. m. s.	° ′ ″	+	+	s.	″	
July 3	6 32 41	− 0 17·38	− 13 2·0	6	8 8 18·96	98 17 56·1	8·7389	9·7146	− 0·08	+ 11·6	1
,, 4	6 31 31	− 0 50·38	− 18 2·6	6	.....	.....	8·7374	9·7117	− 0·06	+ 11·5	2
,, 4	6 31 31	− 4 53·22	− 1 29·1	6	.....	.....	8·7374	9·7117	− 0·05	+ 11·7	3
,, 11	6 55 56	− 0 47·20	+ 1 28·7	5	.....	.....	8·7465	9·7086	− 0·08	+ 11·5	4
,, 11	6 55 56	− 3 46·98	− 2 53·1	5	8 58 0·79	100 13 11·4	8·7465	9·7086	− 0·09	+ 11·5	5
,, 11	6 55 56	− 4 13·12	+ 11 28·4	5	8 58 0·54	100 13 15·5	8·7465	9·7086	− 0·09	+ 11·5	6
,, 11	6 55 56	− 5 21·24	− 4 2·2	5	8 58 2·81	100 13 17·3	8·7465	9·7086	− 0·09	+ 11·5	7
,, 12	6 56 17	+ 0 0·15	+ 6 4·3	10	9 3 24·23	100 23 44·3	8·7431	9·7085	− 0·09	+ 11·4	7
,, 21	6 44 29	− 0 43·03	+ 14 33·7	10	9 44 43·76	101 29 57·9	8·7365	9·6953	− 0·25	+ 10·6	8

Remarks on the Observations of Fabry's Comet.

1886.

May 2.—Comet blurred in consequence of its proximity to the horizon.

3.—Nucleus small and starlike: good observations.

4.—Nucleus still small, but not so bright.

6.—Comet well seen without a telescope: tail = 4° or 5°. Comparisons rather difficult towards the close.

7.—In consequence of the low magnifying power of the square bar eye-piece the nucleus was distinct in a red field.

8, 10, 11 and 12.—Nucleus small and well seen; good observations.

13.—Comet still visible in moonlight to the unassisted eye. The nucleus was not so small, but was pretty well observed. During the 10th comparison, 10h. 49m. sidereal time, the nucleus, which had been directly approaching a star of the

9th mag., became coincident with the latter, and was rendered quite invisible. In this comparison the star was observed for the comet. During the superposition the star appeared somewhat fainter. By occasional glimpses it was seen that the star was preceded a few seconds of arc by a minute companion of the 11th magnitude. The approximate apparent place of the star of the 9th mag. was R.A. = 7h. 16m. 35s., N.P.D. = 122° 5′ 23″.

14.—Comet just visible without a telescope.

20.—Pretty distinct condensation. The moon rose towards the close of the comparisons, and the comet was therefore faint.

21.—The condensation still admitted of fair observation.

22.—Subsequently to the comparisons the comet was superposed on a star of the 10th magnitude. During the superposition the star which had been noticed to be white became reddish.

23.—Central condensation ill-defined.

26.—Sky hazy and comet faint.

30.—Comet much fainter, with slight condensation.

31.—Condensation still visible.

June 1.—Small condensation, which was pretty well observed.

5.—Comet about 1′ in diameter, with some condensation.

7.—Owing to the moon's presence the comet was excessively faint and difficult of observation.

Remarks on the Observations of Barnard's Comet.

May 31 and June 3.—Comet plainly visible to the unassisted eye.

June 10.—During the 7th comparison the comet approached so close to a star of the 10th mag. as to be almost coincident with it. The star appeared somewhat fainter during the appulse.

11.—Slight condensation.

13.—During the 7th comparison with star No. 8 the comet was almost blended with star No. 9, and was therefore excessively faint and difficult to observe. During the 3rd comparison with stars No. 9 and 10 the comet again approached so close to a star of the 8th mag. as to become almost invisible. In the 4th comparison the comet and this star were observed as one object. The comet was excessively faint at the last comparison.

27 and 29.—Comet excessively faint, and observations very unsatisfactory.

July 1.—Comet of the last degree of faintness, and observations very unsatisfactory.

Remarks on the Observations of Brooks' Comet (No. 1).

July 3 and 4.—Comet $1\frac{1}{2}'$ in. diameter, with slight condensation.

11, 12, and 21.—Comet hardly distinguishable.

Adopted Mean Places for 1886·0 of the Stars compared with Fabry's Comet.

No.	R.A.	N.P.D.	Authorities.
	h. m. s.	° ′ ″	
1	4 22 8·47	88 23 44·3	Lalande, No. 8414.
2	4 44 47·43	94 3 42·9	Lalande, No. 9104.
3	5 6 24	99 14 0	Anonymous = 8 mag.
4	5 49 26·79	107 47 39·9	Lalande, No. 11226; Arg-Oeltzen, No. 4420.
5	5 51 6·25	107 53 51·7	Arg-Oeltzen, No. 4450.
6	5 52 32·93	108 4 7·7	Lalande, No. 11334; Arg-Oeltzen, No. 4471.
7	6 8 36·88	111 14 7·7	Arg-Oeltzen, No. 4812.
8	6 16 5·08	114 14 58·4	Cordoba Zone 102, No. 115.
9	6 20 39	114 3 0	Anonymous = 8½ mag.
10	6 44 6·84	118 5 13·6	Arg-Oeltzen, No. 5723; Yarnall, No. 2748; Cordoba Zone 118, No. 14; Stone, No. 3217.
11	6 49 1·63	118 23 5·9	Wash. Mural Cir., Zone 98, No. 26; Arg Oeltzen, No. 5863; Cape Cat. 1850, No. 1117; 2nd Radcliffe Cat. No. 739; Yarnall, No. 2791; Cordoba Zone 118, No. 30; Stone, No. 3272.
12	6 55 16·95	119 32 44·7	Wash. Mural Cir. Zone 91, No. 54; Wash. Merid. Cir. Zone 155, No. 39; Arg-Oeltzen, No. 6027; Yarnall, No. 2830; Stone, 3345.
13	7 2 41·49	119 21 45·6	Arg-Oeltzen, No. 6244.
14	6 56 56·27	119 33 59·9	Wash. Mural Cir., Zone 91, No. 55; Wash. Merid. Cir., Zone 155, No. 41.
15	7 7 40·64	120 37 53·5	Wash. Merid. Cir., Zone 165, No. 63; Arg-Oeltzen, No. 6399; Cape Cat. 1850, No. 1181; 2nd Radcliffe Cat. No. 775; Yarnall, No. 2909; Bruxelles Obs., 1874, No. 371: 1876, No. 325. Stone, No. 3478.
16	7 9 24·04	120 53 19·1	Wash. Merid. Cir., Zone 165, No. 66; Cape Cat. 1850, No. 1186; Stone, 3494.
17	7 12 32·84	120 41 32·8	Wash. Merid. Cir., Zone 165, No. 68; Wash. Mural Cir., Zone 101, No. 1: Arg-Oeltzen, No. 6553; Yarnall, No. 2946; Bruxelles Obs., 1874, No. 382; Stone, No. 3542.
18	7 16 30·96	122 15 48·4	Yarnall, No. 2983; Stone, No. 3589.
19	7 19 11·33	121 58 53·8	Cape Cat. 1850, No. 1232; Stone, No. 3619.
20	7 29 55·31	123 13 4·1	Yarnall, No. 3083; Stone, No. 3727.
21	7 31 31·99	123 8 25·2	Yarnall, No. 3097; Stone, No. 3744.
22	7 54 26·38	126 42 15·6	Wash. Merid. Cir., Zone 171, No. 18; Yarnall, No. 3262; Stone, No. 4024.
23	7 57 54·80	126 43 59·6	Wash. Merid. Cir., Zone 171, No. 19; Cape Cat. 1850, No. 1386; Yarnall, No. 3274; Melb. Obs., 1877, No. 122; Stone, No. 4076.
24	7 57 27·22	126 58 3·1	Stone, No. 4071.
25	8 6 49·06	126 57 14·1	Cape Cat. 1850, No. 1424; Stone, No. 4176.
26	8 4 26·85	127 20 56·2	Wash. Mural Cir., Zone 234, No. 17; Yarnall, No. 3306; Stone, No. 4147.
27	8 8 40·71	127 34 33·1	Stone, No. 4207.
28	8 22 6·71	128 41 8·1	Wash. Merid. Transit, Zone 223, No. 5; Stone, No. 4354.
29	8 27 59·35	129 34 0·8	Stone, No. 4440.
30	8 29 58	129 20 0	Anonymous = 7½ mag.
31	8 31 0·89	129 34 43·7	Cape Cat. 1850, No. 1513; Stone, No. 4482.
32	8 33 12·37	129 45 2·7	Stone, No. 4512.
33	8 36 8·24	129 51 35·1	Cape Cat. 1850, No. 1534; Melb. Obs., 1880, No. 147; Stone, No. 4539.
34	8 47 42·31	130 33 29·8	Cape Cat. 1850, No. 1589; Melb. Obs., 1880, No. 152; Stone, No. 4707.
35	8 48 27·91	130 33 13·1	Stone, No. 4715.

Remarks:—Star, No. 14.—The minutes of declination of this star are misprinted 30′ for 31′ in the Wash. Mural Circle Zone, 91. Star, No. 15. The Radcliffe R.A. of this star has been rejected. Star, No. 17.—This star = 7 mag.; it had a companion of the 8 mag. south of it. The R.A. in Wash. Merid. Circle Zone, 165, is rejected.

Adopted Mean Places for 1886·0 of the Stars compared with Barnard's Comet.

No.	R.A.	N.P.D.	Authorities.
	h. m. s.	° ′ ″	
1	4 52 23·74	113 13 5·5	Arg-Oeltzen, No. 3528.
2	4 57 56·18	112 57 32·8	Radcliffe Cat. 1845, No. 1400; Arg-Oeltzen, Nos. 3600 and 1; Cape Cat. 1850, No. 735; 2nd Radcliffe Cat. No. 572; Greenw. 7 Yr. Cat. 1864, No. 641; Cordoba Zone, 82, No. 70; Stone, No. 2202.
3	5 35 36·90	122 41 22·3	Cape Cat. 1850, No. 867; Yarnall, No. 2362; Stone, 2550.
4	6 44 40	134 12 0	Anonymous=8 mag.
5	6 48 2	134 20 0	Anonymous=8 mag.
6	6 46 38·16	135 18 56·7	Stone, No. 3247.
7	6 55 52·70	135 4 13·3	Stone, No. 3353.
8	7 11 29·65	136 39 1·1	Cape Cat. 1850, No 1202; Stone, 3527.
9	7 11 7	136 55 0	Anonymous=8½ mag.
10	7 14 13·24	136 47 32·9	Stone, No. 3567.
11	8 23 16·34	142 25 56·6	Cape Cat. 1850, No. 1482; Stone, 4372.
12	8 23 48·91	142 19 36·5	Cape Cat. 1850, No. 1485; Stone, 4379.
13	8 37 1·68	142 31 3·1	Cape Cat. 1850, No. 1540; Melb. Cat. 1870, No. 430; Stone, No. 4555.
14	8 36 42·68	142 39 3·4	Cape Cat. 1850, No. 1538; Stone, No. 4549.
15	8 37 2·19	142 36 40·1	Cape Cat. 1850, No. 1541; Stone, No. 4556.

Adopted Mean Places for 1886·0 of the Stars compared with Brooks' Comet (No. 1).

No.	R.A.	N.P.D.	Authorities.
	h. m. s.	° ′ ″	
1	8 8 36·41	98 30 46·5	Lalande, No. 16132.
2	8 15 57	98 17 0	Anonymous=7½ mag.
3	8 20 0	98 34 0	Anonymous=7 mag.
4	8 58 48	100 12 0	Anonymous=9 mag.
5	9 1 47·68	100 16 23·0	Lalande, No. 18013.
6	9 2 13·57	100 1 45·2	Lalande, No. 18030.
7	9 3 23·99	100 17 28·6	Lalande, No. 18069.
8	9 44 0·50	101 15 13·6	Lalande, No. 19282; Lamont, 599.

Remark :—Has Lalande, No. 18069, a considerable proper motion in right ascension?

Mr. RUSSELL said he had great pleasure in proposing a vote of thanks to Mr. Tebbutt for his paper on his observations of these recent comets. All of them had been frequently observed at the Sydney Observatory, and a more extended series of observations had been made with a large equatorial, which had enabled him to carry on the observations for several days after those of Mr. Tebbutt. It was necessary, he thought, that all the observations of astronomers on such matters should be placed together and compared, and accordingly his notes had been forwarded to England for publication some time since.

Notes on some Rocks and Minerals from New Guinea, &c.

By A. Liversidge, F.R.S., Professor of Chemistry in the University of Sydney.

[*Read before the Royal Society of N.S.W., 1st December, 1886.*]

Preliminary Notice.

The specimens mentioned as having been obtained from the Fly River were collected by Signor D'Albertis, and those from Yule Island, Gulf of Papua, by the late Captain Onslow, R.N.

An account of these specimens was not published earlier because I have hitherto hoped to make chemical and microscopical analyses of the most important, but this work must be postponed for a more favourable time. I also expected to receive an account of the fossils which accompanied the rocks from Prof. P. Martin Duncan, to whom they were sent for description, but up to the present no information upon this point has been forthcoming; hence this is intended merely as a preliminary note.

The fossils were mainly of a Mesozoic character, including *belemnites*, *pectens*, *ammonites*, *carcharodon teeth*, *coral*, &c., and seemed to have been derived from Cretaceous rocks.

Signor D'Albertis states that all the specimens which are not otherwise noted are from the Fly River, in about Lat. 5° 30′ S., some 250 miles in the interior.

Quartz.—In the form of white rolled pebbles with a few imperfect crystals in parts, apparently derived from a vein.

These were tested for gold by the dry way, but none was found to be present.

Some of the quartz pebbles were very brittle, and had evidently been subjected to the action of fire, probably they had been used for lining cooking pits.

Quartzite.—Grey, almost white, tender, glistening, and under the microscope most of the grains present one or more crystal faces, and many are fairly complete hexagonal pyramids. So friable that it can be rubbed down between the fingers. These pebbles also have probably been used in fireplaces. They were found to be free from gold.

Also, heavy, hard, and compact quartzite pebbles, containing minute disseminated particles of iron pyrites; the sp. gr. is 2·599. The quantity of pyrites is very small; these were found

to contain minute traces of gold, but only by operating upon large quantities.

Some of the pebbles of quartzite were black, others only black in the interior; the former had probably not been burnt in the native fireplaces.

Flint.—In the form of light brown pebbles, somewhat like those from the Woolwich beds; others, containing more impurity, and some resembling Egyptian jasper.

One flint pebble bears the imperfect cast of a *pecten*, and in others are markings somewhat spongiform in appearance. One is perforated by a tube about 2 inches long, containing a movable core of light porous siliceous matter about $\frac{3}{4}''$ in diameter.

In one case the flint has a sp. gr. of 2·586, and in another 2·570.

Conglomerate.—A pebble containing rolled fragments of white quartz, pale brown felspar, some showing twinned crystals, and black asper or basalt, cemented together by a black ferruginous paste.

Basalt.—In the form of a pebble of porphyritic structure, and containing large crystals of augite. Another specimen, in the form of an almost spherical pebble, broke with a sub-conchoidal fracture, and showed weathering for about $\frac{1}{8}''$ from outer surface.

The specific gravity was low, being only 2·678.

Porphyry.—Small pebble of a red colour, an intimate mixture of red orthoclase felspar and quartz, a little hornblende and mica present. The exterior of the stone is quite black, and probably like most of the others, was taken by Signor D'Albertis from a fireplace.

Iron Pyrites.—In dark liver-coloured masses, showing radiate structure when broken open (Marcasite); in appearance very like that from the Lias clay. Rapidly oxidizes to sulphate.

Was found on assaying to yield minute traces of gold.

Limonite.—In the form of nodules with a concentric structure. Some are hollow inside; others have a loose nucleus or kernel inside, and in flat cake-like masses, of fair quality as an ore of iron.

Also as bright red and yellow ochres—one specimen was in a calabash, and the other wrapped in ti-tree bark—probably ready for use as pigments and personal adornment.

There are also specimens of ferruginous unctuous clays of red, brown, pink, and grey colours, from the banks of the Katau and Fly Rivers.

Limestone.—Compact, somewhat crystalline, no fossils, weathered outside; evidently from the sea shore, since one piece has an oyster shell attached.

A fragment of stalactitic aragonite, but blackened and saturated with tarry matter.

One stalagmitic mass was found to be hollow like a geode, and the cavity lined with small quartz crystals.

Amongst the calcareous specimens are pebbles made up of rolled

masses of corals cemented with calcareous matter ; in other cases made up of silt and volcanic ashes, also cemented together by calcium carbonate.

Also white and grey slightly crystalline limestones containing fossil corals. One piece of limestone has weathered into a peculiar spathulate form, and might almost have been mistaken for a native spoon.

There are several specimens of a yellow granular friable lime stone containing fragments of various fossils, corals, &c., with waterworn surfaces and bearing attached oyster shells in places.

Lignite.—Yarrn Island, 3 miles from the mainland of New Guinea. Of a brown colour, with lamellar structure where weathered, somewhat like dysodile ; exhibits a woody structure, gives a brown streak or powder, breaks with a well marked conchoidal fracture yielding a black lustrous surface. Burns with difficulty without flame, emits but little smell, and leaves a dark grey ash, very bulky and resembling a wood ash.

It is not sectile, but flies off in powder before the knife.

Fossil Wood.—Many specimens were found in the natives' fire-places, some of them presenting very curious and fantastic shapes ; the woody structure is well preserved, on the outside they are brown but black and porous within. The black portion when crushed and ignited on platinum foil glows feebly, and leaves a white ash, but can hardly be said to burn. This mineralised wood, for it consists mainly of silica, is probably used by the natives merely to line their fireplaces just as they use the rocks and pebbles, and not for any value it possesses as a fuel.

Pumice (from the Katau River).—In the form of a rolled mass of a light grey colour, very similar in appearance to the common white pumice of New Zealand and other Pacific sources.

Most of the stone implements, adzes and club heads, many of the latter being in the form of rings, stars, crescents, &c., are made of hard igneous crystalline rocks ; some are apparently from modern lavas, but others of older basalts, diorites, and porphyries ; but it was difficult to determine the rock with certainty in many cases, on account of the glaze-like black polish which they possessed, and which Signor D'Albertis did not wish removed ; and to obtain fresh fractures was, of course, out of the question without also destroying their value as ethnological specimens.

The egg-shaped stones are fashioned out of a variegated lime stone, and the sharpening stones or hone is a grey felsitic rock.

The following specimens were collected by the late Captain Onslow, R.N., in August, 1875 :—

Yule Island.

The specimens from Yule Island consist simply of quartz pebbles. Some pieces of white, more or less crystalline limestone,

apparently from a coral reef; and others of a grey colour, one of which, evidently coral reef debris, enclosed rolled white quartz and other pebbles.

Darnley Island.

With the above are a few specimens from Darnley Island. These consist of a black vesicular lava containing some carbonate of lime in the cavities; a rolled nodule of basalt, and a fragment of a buff coloured tufaceous rock, containing a considerable amount of carbonate of lime in the form of recognisable fragments, but most of it disseminated in fine grains mixed with iron oxide.

On treating a fragment of the rock with hydrochloric acid, it dissolves in great part, and leaves a grey coloured residue which, under the microscope, has the appearance of a volcanic ash; fragments of green augite, brown and colourless crystals, being abundant.

Baxter River (New Guinea).

Rolled nodules of white vein quartz, with a pebble of grey coloured chalcedonic quartz; of a basalt and of a dark grey felsitic rock; another specimen is a pebble of a dark coloured very tough diabase rock.

Concretions of impure red hæmatite, like those occurring in the Wianamatta shale, and like them probably derived from a shale.

Various specimens of alluvial deposits obtained from the river banks, passing from loose grey and black soils to stiff and tenacious red clays. One of these is laminated like a shale and contains mica scales: it is probably the source of the ironstone concretions.

The scales of mica apparently indicate the presence of older crystalline rocks in the interior.

Obtained from 35 miles up the river. Some of the soils are very full of vegetable matter, and should be very fertile.

Lole.—Of a red colour, also variegated red and white; adheres to the tongue, and scales off in fragments with a conchoidal fracture; gives shining streak, and is subtranslucent. Falls to pieces when placed in water with a slight crackling sound, and emits a rapid stream of minute air bubbles.

Chrysolite.—Small pale green rolled pebbles, fairly transparent; all external crystalline form worn off. Collected by the Rev. G. Brown in Samoa.

Aragonite.—In the form of stalactites from Tanna.

Sulphur, *sulphates*, and similar volcanic minerals, are common in Tanna and some of the other islands.

As a whole, the variety of minerals at present obtained from New Guinea and the islands is very limited.

Notes on some New South Wales Silver and other Minerals.

By A. Liversidge, F.R.S., Professor of Chemistry and Mineralogy in the University of Sydney.

[*Read before the Royal Society of N. S. W., 1st December, 1886.*]

Most of the silver minerals placed before you and mentioned in the following notes were collected by Mr. J. M. Smith, a member of this society, and many of the assays were also made by him.

Native Silver.—The specimen of native silver placed before you is from the Umberumberka Mine, about 11 miles from Silverton, and was obtained at a depth of about 240 feet, where the vein is about 4 feet wide. It is in the form of thin scales, and is associated with galena and siderite, the layers or scales of silver being attached for the most part to the galena.

Silverton is situated in the Barrier Ranges, and is about 822 miles west of Sydney, and 15 miles from the South Australian border; but the silver bearing country is said to extend some distance round, 30 or 40 miles, and from Mundi Mundi on the west, to Mount Gipps on the east.

Silver chloride.—Specimens are placed on the table obtained from the surface of mines in the Silverton district, and from various depths in the different mines. The loose masses found on the surface have usually a dirty green or brownish colour, and are known by the miners as "slugs"; on cutting them or driving into them with a pick they present the usual characteristics of masses of silver chloride, being very tough and horn-like, and yielding a smooth shining surface, and, if the knife be wet, a metallic silver surface. They sometimes weigh many pounds, but are usually much less.

One specimen which was examined yielded the following result to Mr. Smith :—

Sample from 212 feet level, Broken Hill Mine, Barrier Range :—

Chloride of silver	...	...	81·67
Bromide of silver	...	...	10·19
Oxide of iron Alumina, silica, &c.	...	...	8·14
			100·00

The vein stuff is sometimes earthy, at others it consists largely of chlorite, and in other instances it contains bluish chalcedonic translucent quartz; at times it is mainly ferruginous.

At the Broken Hill Mines also, at the 150 feet level, the silver chloride was found associated with chrysocolla, *i.e.*, hydrous copper silicate. At the 100 feet and 212 feet levels the vein had a porphyrytic structure, and the silver chloride was mixed with earthy grey copper sulphide (redruthite), and was associated with small crystallised red garnets; at the 212 feet level cuprite and quartz were also present in addition to the copper sulphide and other minerals.

Large quantities of cerussite, *i.e.*, lead carbonate, and galena seem to be present throughout most of the veins, so that smelting should be easy.

In some cases the vein has proved to be very rich in silver, 48 tons of the ferruginous part of the vein at Broken Hill Mine yielded 37,000 ounces of silver, although by the method of smelting followed the loss must have been, as was alleged, very great. In another case 1,300 ounces of silver per ton is said to have been obtained. In some cases the silver chloride is very well crystallised, the octohedra are quite one-eighth of an inch in length and fairly distinct, being however generally attached to one another in incipient branching forms, with a horn-like translucency, and of a greenish shade.

In some cases where the silver chloride is crystallised on a velvet black or brown hæmatite, the effect is very fine and the appearance is really very beautiful. This form is also found at the Broken Hill Mine, and associated with the silver chloride are small yellow crystals which appear to be minute imperfect hexagonal prisms of silver iodide, but I have not yet confirmed the presence of iodine.

In one vein at the Broken Hill the vein stuff is a white earthy mineral resembling kaolin, and the vein is known as the Kaolin vein in consequence. The greenish crystals and plates of silver chloride crystallised on some of the slicken-side surfaces of the kaolin have a very pretty effect.

Specimens are shown you from the following mines, in addition to those from the Broken Hill Mines:—Christmas Mine, Lubra Mine, War Dance and Gipsy Girl Mine, Thackeringa, North May Bell Mine, Silverton, Day Dream, Hen and Chickens Mine where the silver chloride occurs with azurite or blue copper carbonate.

Selected specimens, of course, assay very high, one piece of the vein from the Lubra yielded 8,493 ounces of silver per ton, and a yield of 16,000 ounces has been obtained from surface slugs.

Iodargyrite.—Silver iodide, the probable presence of this has been already mentioned.

Cerussite.—Lead carbonate occurs in association with the silver chloride, galena, &c., in the Silverton Mines, sometimes fairly crystallised. The cerussite appears to be free, or almost free from silver, the latter having been deposited on its surface merely.

Anglesite (lead sulphate).—Occurs under much the same circumstances as the cerussite, and at times the crystals, although usually small, are brilliant and well formed.

Fahlerz, occurs at South Wiseman's Creek Mine in the Bathurst district, and at Webb's Silver Mine, Vegetable Creek, New England, at the latter mine a few small crystals have been met with. Similar antimonial and arsenical silver ores were worked at Boorook and other places near Tenterfield.

At Webb's Mine the fahlerz occurs with galena, copper sulphides, green fluor-spar, &c.

Manganese.—A mineral which looks like psilomelane occurs at the Broken Hill Mine, and was met with at a depth of 6ft. in cutting a trench on the outcrop of the lode. It is smooth, black, and shining in mammillated stalactitic form, and upon its surface crystals of silver chloride have been deposited in many cases. The specimens placed before you were brought down by Dr. G. S. Mackenzie, and he tells me the mineral is locally used as a flux in smelting the silver ores; on analysis he found it to contain 19·00 per cent. lead, probably present as carbonate; 20 per cent. silica; 37·88 per cent. manganese (metallic), probably present as dioxide; 3·02 per cent. alumina; 2·97 per cent. iron. Another specimen which he also partially analysed, from the South Broken Hill Mine, about $\frac{1}{2}$ mile south of the outcrop whence the previous one was found, yielded 6·20 per cent. silica; 28·85 per cent. iron; 21·10 per cent. manganese, probably present as dioxide; 14·00 per cent. lead, probably present as carbonate. They both contain lime, &c., but the other elements have not been estimated.

Cassiterite.—Some large well developed crystals of brown tinstone in quartz, about $1\frac{1}{2}$ inch in diameter, from Jingellic Mine on the Upper Murray.

Zincite.—Red oxide of zinc, mistaken by local miners for calamine, from the Vegetable Creek, New England.

Topaz.—Fairly well crystallised topaz from Scrubby Gully, New England, from $\frac{1}{2}$ inch to $1\frac{1}{2}$ inches long.

Beryl.—A rolled fragment of about $\frac{1}{2}$ inch × $\frac{3}{4}$ inch, not of very good colour, and much flawed.

Garnets.—Common red, crystallised in chlorite, from New England.

Diamonds.—In twin crystals of imperfect three-faced octohedra, united by a plane parallel to a face of the octohedron. Sent by Mr. C. S. Wilkinson; obtained from the Sydney Diamond Mining Company, near Inverell. A collection of minerals accompanying the diamonds in the Bengonoway Diamond Mine, is also exhibited. Although these are somewhat the same as occur at Bingera there are well marked and characteristic differences.

On the Composition of some Pumice and Lava from the Pacific.

By A. Liversidge, F.R.S., Professor of Chemistry in the University of Sydney.

[*Read before the Royal Society of N.S.W., 1 December, 1886.*]

Bondi.

Pumice.—Masses of pumice are frequently cast upon the beach along the coast of New South Wales, and at times are also found in the harbours, and they are not unfrequently picked up within the Sydney harbour.

The source of this pumice is, of course, a foreign one, and doubtless it is derived from more than one of the volcanic centres in the Pacific, but which of them does not as yet appear to be very clear.

It is always waterworn, and at times more or less coated with serpulæ, and has evidently been long in its travels across the sea. It is stated to be more abundant after an easterly gale, and is found more often on the north side of the inlets along the coast than in other situations; in size the pieces vary from quite small fragments to pieces 9 or 12 inches through.

Some of the specimens are black and others are white, or rather of a dirty white or grey colour.

Thinking that the chemical composition might throw some light on their source, analyses were made of a specimen of each variety with the following results :—

Black pumice.—Bondi beach.

Chemical composition :

Moisture	·147
Silica	63·630
Alumina	17·994
Iron sesquioxide	5·838
Iron monoxide	traces
Manganese monoxide	·691
Lime	4·205
Magnesia	none
Soda	4·252
Potash	3·809
	100·566

Sp. gr. 2·307 at 15°C. in powder.

White pumice.—Bondi beach, much waterworn.

Chemical composition:

Moisture	1·818
Silica	68·149
Alumina	16·493
Iron sesquioxide	3·255
Iron monoxide	none
Manganese	·256
Lime	4·005
Magnesia	none
Soda	3·881
Potash	1·590
	99·447

Sp. gr. 2·107 at 18°C. in powder.

I have not been able to analyse any of the specimens of pumice from the islands, so that no direct comparison can be made between their composition and that of the drift pumice, but on comparing the above analysis with those of the Krakatoa pumice of the 1883 eruption, a very great resemblance is at once seen, although there are points in which they differ in composition; the most striking being the absence of any magnesia in the Bondi specimens. Although the Bondi specimens were collected some years before the Krakatoa eruption of 1883, they may possibly have been drifted across from previous eruptions in that district.

It would be very interesting to trace the limits of the distribution of drift pumice along the Australian coast, and I trust that some one will undertake this duty.

Lava.—Chocolate coloured, from the island of Tanna, very vesicular and almost a pumice in structure (*See* Rocks from New Britain and New Ireland, A. Liversidge, F.R.S., Journ., Roy. Society, N.S.W., 1882); and in specific gravity it is just over 1·0, since it slowly sinks in water, but the powder has about the usual density of rocks.

It also contains small white glassy crystals of felspar. This specimen was collected by the late Commodore Goodenough.

Chemical composition:

Moisture	·201
Silica	57·041
Alumina	19·512
Iron sesquioxide	5·499
Iron monoxide	2·714
Manganese monoxide	2·053
Lime	8·157
Magnesia	none
Soda	2·831
Potash	2·375
	100·383

Sp. gr. 2·720 at 21·2°C. in powder.

Lava.—From Port Resolution, Island of Tanna. This is a black vesicular rock, with a pitchy or resinous lustre on the freshly fractured surfaces. The weathered surfaces are brown, and in the interior of some of the vesicles scattered through the lava are white glassy crystals of felspar.

Chemical composition :

Hygroscopic moisture	·139
Silica	53·312
Alumina	9·007
Iron sesquioxide	17·339
Iron monoxide	2·002
Magnesia	·727
Lime	9·058
Manganese monoxide	1·443
Soda	3·417
Potash	3·347
	99·791

Sp. gr. 2·686 at 15°C.

The proportion of iron to this rock is unusually large.

Lava.—From the island of Tanna. This is a black scoriaceous and vesicular lava: the freshly fractured surfaces are highly lustrous, like the former lava it contains isolated small glassy crystals of felspar.

Chemical composition :

Moisture	·241
Silica	56·755
Alumina	21·096
Iron sesquioxide	4·521
Iron monoxide	3·021
Manganese	traces
Magnesia	,,
Lime	9·014
Soda	2·804
Potash	3·272
	100·724

Sp. gr. 2·666 at 15°C.

Thus there is a considerable difference in the composition of these two lavas.

Comparative Table.

	White pumice, Bondi.	Black pumice, Bondi.
Moisture at 100°C	1·818	·147
Silica	68·149	63·630
Alumina	16·493	17·994
Iron sesquioxide	3·255	5·838
Iron monoxide		traces
Manganese monoxide ...	·256	·691
Lime	4·005	4·205
Magnesia	none	none
Soda	3·881	4·252
Potash	1·590	3·809
	99.447	100·566
Sp. gr.	2·107	2·307

	Krakatoa, 1883. 1.	2.	3.	Chocolate lava, Tanna.	Lava, Port Resolution.	Lava, Tanna, Scoriaceous.
Loss on ignition ...	2·17	2·74	2·12	·201	·139	·241
*Silica	63·30	65·04	68·06	57·041	53·312	56·755
Alumina	14·52	14·63	15·03	19·512	9·007	21·096
Iron sesquioxide ...	5·82	4·47	·28	5·499	17·339	4·521
Iron monoxide ...		2·82	3·66	2·714	2·002	3·021
Manganese	·23	trace	trace	2·053	1·443	traces
Lime	4·00	3·34	2·71	8·157	9·058	9·014
Magnesia	1·66	1·20	·81	none	·727	traces
Soda	5·14	4·23	4·25	2·831	3·417	2·804
Potash	1·43	·97	3·41	2·375	3·347	3·272
*Titanic acid ...	1·08	...	·38	...	...	...
	99·35	99·44	100·71	100·383	99·791	100·724
Sp. gr.	...	...	...	2·720	2·686	2·666

No. 1 by Sauer, No. 2 by Renard, No. 3 by K. Oebbeke. Journ. Chem. Soc. 1884, p. 974-5.

Discussion.

Mr. G. A. Lloyd, M.L.A., said it was a matter of very great importance that such subjects should be studied and brought more prominently before the public. When gold was discovered in California in 1850, the export of that metal was very great, and so it continued for several years; but after a time the out-put of gold decreased, and silver took its place. In travelling through Nevada recently, he had the opportunity of speaking to several of the principal mine-managers, and went through every portion of two or three of the mines, from which a large quantity of silver and lead had been brought to market. He found the quartz to be very much like that found here. Many men in some of the American mining districts who had been proprietors of shares in silver-mining companies had made fabulous fortunes—became silver kings in fact. We were passing through a similar mining history to that of America; we are just beginning to discover the silver, and although, up to the present we have been merely scratching the surface, we are getting in this way fair quantities for our labour. There is no doubt that the information we are getting from Broken Hill and Sunny Corner proves that there is a great future for the silver-mining industry in the colonies. The outputs from the two places mentioned may increase to an enormous extent, and any information that is given by scientific men cannot fail to be extremely welcome. All the members present would agree with him that, if by increasing our scientific knowledge we could augment our commercial prosperity, we should achieve something quite in accord with the objects of the Society. He then suggested that the meetings should be of a more popular character, and that lectures similar to those delivered before the societies elsewhere would be well received.

Mr. C. S. Wilkinson said we were indebted to Professor Liversidge for the information imparted respecting the geology of New Guinea. During the Australian Geographical Society's expedition up the Strickland River, the Cretaceous formation was found almost along its whole length; and on ascending one range it seemed as if the country were almost flat and undulating, showing that the Cretaceous formation, in all probability, extended in that direction. Professor Liversidge's observations now prove this to be the case, and form a very important contribution to our knowledge of that part of New Guinea.

Notes upon Floods in Lake George.

By H. C. Russell, B.A., F.R.S., &c.

[*Read before the Royal Society, N.S.W., 1 December, 1886.*]

The history of floods in our rivers and lakes, if it could be accurately written, would form one of the most important chapters in the history of our climate, and probably throw much light upon the laws which control the changes in seasons that have such prominent effects upon a country like this, almost wholly devoted to pastoral pursuits. It is, however, impossible now to find the materials for such a history, and the few facts which have rewarded me for some considerable time devoted to the enquiry, seem under these circumstances of sufficient importance to place before you; in order to make the record permanent, and if possible draw from the recesses of memories still active, important testimony upon the question under discussion. So far as I have been able to gather the opinions of those who know most about Lake George, they do not seem to have shaped themselves into anything like a theory, which would place limits of time, and extent to the floods which have from time to time covered up tens of thousands of acres of the richest pasture land for years, and I have not therefore to detain you by discussing any theory which has already been given to the world. And before giving my own view upon the subject, I should like to call your attention to the fact that the floods in a lake which has no outlet produce very different effects from those we see in rivers. In the latter case the water speedily returns to its level and leaves a record for the season in which it took place. But in the lake a similar flood produces an accumulation of water which takes many years to evaporate, and to a certain extent masks the effects of subsequent rains, such at least is the case in Lake George, which has no outlet except evaporation. My object in collecting these facts was two-fold; first, to preserve them for future reference, and secondly, to see if they would throw any light upon the nineteen years period which is so well marked in the floods in the river Darling; but in the lake the accumulation of water seems to soften out the curves, and the particular floods cannot be seen so well, and in some cases not at all, and then the history of the rising and falling of the lake is too incomplete.

Only a small ridge divides the catchment of the lake from that of the Hawkesbury River, and we know from rain observations

made at Goulburn on the Hawkesbury side of the lake, and at Gungahleen on the other side, that the average rainfall on the two catchments there is about the same. So that very heavy floods in the river coincide in time with very heavy floods in the lake. I mention this because from it we may reasonably infer the state of Lake George from the state of the Hawkesbury during the years 1816, 1817, and 1818. In the autumn of 1816 there were three great floods in the Hawkesbury, while the three preceding years had been very dry, and there seems to be no doubt that in 1816 the lake suddenly rose, as shown in the diagram, for when found in 1818 it was "full of water."

I have been working now for many years trying to elucidate the sort of mystery that seemed to hang about Lake George, and with a view of getting reliable data as to the rise and fall of the lake and other matters, on February 18th, 1885, I erected the lake register described in my anniversary address to the Royal Society, May, 1885, and took the 0 line of its printed sheet as datum line, there being at the time no other available ; the recording pencil was made to mark at the zero, so that the water level on February, 1885, is the zero of the lake register. But it was known that careful levels had been taken of the base line at the other side of the lake, and that Mr. Chisholm, Mr. Kenny, and others had frequently noted the condition of the lake and measured the depth of the water ; and it was obviously very desirable to connect all these measures, and also the still older ones on the original surveys of the land round the lake. These go back to 1828 and are invaluable as reliable data amongst much that is unreliable. I began by measuring in twelve places, some distance apart, the difference in level between the 1874 flood line and the then height of the water. Some of the flood marks were black rings on dead trees, and others the well defined gravel line marking high-water. None of these marks were as definite as one could wish ; but the variation in the different measures was only $1\frac{1}{2}$ inches, and the mean of all gave 11 ft. 11 in., which was near enough for my purpose. As I collected the records it became evident that to tie them all together it would be necessary to do four things. First, to take a line of levels from the top of the terminal stone of the base line to the water, which would connect the base line datum with the lake register datum. Next to take sounding of the lake over the same ground that Mr. Chisholm had gone before, and to find the deepest place. This would connect Mr. Chisholm's soundings with the lake register datum, and collect all notes in which the depth of the lake was given ; and thirdly, to find the fall per mile at each end of the lake, so that the surveys and references to the size of the lake might be converted into statements of the height or rather depth of the water, and thus connect them with all the others ; and lastly, to find the present length of

the lake. In the first few days of January, 1887, Mr. Glover carried out these measures for me, and reports as follows: "January 9th, 1887, I have taken the levels from the top of the south terminal of the base line near Mr. Powell's house to the water, and find the difference is 59·84 feet. I have taken the soundings over the same places that Mr. Chisholm sounded, and find the deepest place is 8 feet 2 inches, the other particulars of sounding will be found on the plan of the lake. I find that at the south end of the lake the rise in 60 chains is 10·28 feet, that is, from the present water line towards high-water mark there is a rise of 10·28 feet in 60 chains; but this rate is not maintained in the water, for there I found that from the edge of the water to a distance of 1 mile in the fall was only 4 feet.

At the north end of the lake the change of level is not so rapid there from the water (present edge) 1 mile towards the high-water mark there is a rise of 7·07 feet, and in 1 mile the other way; that is, into the water there is a fall of only 1·80 feet. I carried the levels also from the water up over the first gravel ridge into the wet lagoon, *i.e.*, the gravel ridge that Mr. Beit cut through in order to drain the lagoon. I found the top of the gravel ridge 32·90 feet above the water, and the bed of the lagoon is 16·08 feet above the water, and therefore 16·82 feet below the gravel ridge. I have sounded the lake over the lines on Mr. Chisholm's rough plan, and find the water in Cooper's Bay 8 feet 2 inches where he makes it 21 feet, and the deepest place is in the middle of the lake 9 feet 1 inch."

"I find the railway marked tree at the end of the water at the south end is 62, and at the north end 32, the lake is therefore now 15 miles long."

"I may mention that from the present water to high-water mark at the south end is 73 chains, and at the north end 100 chains." The details of these levels will be found on the map and on the section of the lake.

It will be seen in the section that the lake was sounded for 1 mile at each end, and for a short distance in the middle, and it has been assumed that the bottom is fairly uniform in slope.

In taking the levels Mr. Glover started from the top of the cap on the south terminal stone of the base line, but the base line levels were to the mark under the cap, *i.e.*, 0·75 feet below Mr. Glover's point. We may now see how these connections come out

Base Terminal above Bottom of Lake.

	feet
Top of base terminal to water, 9th January, 1887 ..	59·84
Depth of water in deepest part, 9 feet 1 inch ..	9·08
Difference from top of stone terminal to bottom of lake	68·92
Cap of pier	0·75
Base Line terminal mark above bottom of lake ...	68·17

Again,

1871, August, lake water by section of lake below south terminal...	49
Depth of water then by sounding	19
Bottom of lake to top of south terminal of base ...	68

1874 *Flood Level below South Terminal of Base.*

	ft.	in.		feet
				59·84
Base terminal above water, 9th January, 1887 ...	59	1	=	0·75
				59·09
Lake register datum above January, 1887, level ...	2	11		
Lake register datum below base terminal	56	2		
Lake register datum below 1874 flood	11	11		
1874 flood water below base terminal, south end ...	44	3	=	44·25

Depth of water in 1874 *Flood.*

	ft.	in.
By Mr. Chisholm's soundings	24	6

Again,

Base terminal above bottom of lake	68	2
1874 flood below base terminal	44	3
Depth of water in 1874 flood	23	11

Again,

	feet	
South terminal of base by survey	2,274	above sea.
June, 1878, railway level made water in lake ...	2,225	
Difference	99	

	ft.	in.
In June, 1878, the water was below base terminal...	49	0
Bottom of lake is below base terminal	68	2
Depth of water in June, 1878, by survey	19	2
Railway surveyor made the water 5 ft. 6 in. below 1874 level in June, 1878	5	6
Depth of water in 1874...	24	8

Depth of water in June, 1878.

Depth of water in 1874 flood—Mr. Chisholm ...	24	6
Railway surveyor measured the difference between 1874 flood and water in June, 1878, and made it 5 ft. 6 in.	5	6
	19	0
Depth of water in 1874 flood—Mr. Chisholm ...	24	6
January, 1878, water 4 ft. 7 in. below 1874 flood; evaporation half-year 10 in., to June, 1878 ...	5	5
	19	1

In June, 1878, as will be seen the three measures agree within 2 inches, which is satisfactory. But if we take the depth of the lake in 1874 flood from the levelling it comes 23 ft. 11 in., or 7 in. less than Mr. Chisholm makes it. A difference which cannot be considered large when the level of the water varies so much under the action of wind.

In February, 1885, I determined the fall from 1874 flood as stated above, and made it 11 ft. 11 in. Since then to January, 1887, the lake has fallen 2 ft. 11 in., or in all 14 ft. 10 in., and I have used Mr. Glover's determination of the difference between the bottom of the lake and the base line terminal, because these levels and soundings were carefully taken about the same date. Now Mr. Glover found the deepest water 9 ft. 1 in., which added to 14 ft. 10 in., makes 23 ft. 11 in., as the depth of the lake found in this way. In 1874 flood Mr. Chisholm made it 24 ft. 6 in. I mention these differences to show what uncertainty attaches to them ; but the constant register of the lake shows such variations in level, sometimes amounting to a foot, that I am not surprised at a difference in the depth of the lake found by measures quite unconnected.

These values of the depth of water in the lake, depending upon different persons and measures and methods, show a satisfactory agreement, and make it evident that the connecting links of the different measures are sufficiently accurate for the present purpose ; and it will be seen in reading through the statements collected from various sources that many apparently loose statements can now be converted by means of this knowledge of the lake into useful data, and the majority are very consistent. In one or two cases, however, the rate of fall in the level of the lake owing to evaporation seems to be too great. For instance, it is stated that the water was probably at its highest in June, 1823, and some trees were then standing in it which had been killed by the rise in the water, and had not then lost their bark, while others further in were quite bare. The water must therefore been about as high as in 1874, *i.e.*, 24 ft. 6 in. deep. In 1828 a survey was made of the lake by surveyor Dixson, who made it 15 miles long, the same as it is now, January, 1887, and hence only 9 ft. 1 in. deep, showing a fall of 15 ft. 6 in. in five years, which is much more rapid than any recent measures have shown ; but on the other hand in 1826, '27, and '28 drought was very severe, and the lake would dry up faster than usual. It is, however, quite certain from our present experience of the rate at which the water evaporates out of the lake that it was not dry in 1832, as stated in my work on the climate, upon the authority of Mr. Styles, and we have surveyor Hoddle's survey made in 1832, which conclusively proves that in 1832 the lake was almost exactly the same depth as in January, 1887. Now there seems to be no doubt

that in 1823 the lake was as high as it was in 1874. for it is stated on good authority that the trees extended some distance into the water, and on the margin were some that had been recently killed, and had not lost their bark, while further in were others that looked as if they had been dead for years.

A description that serves exactly for 1874, except that when I went along the western shore in January, 1885, looking for indications of recently killed trees I could see none, except here and there, perhaps one in a mile ; a tree just on the edge of the 1874 flood line, or a little above it, that was dead or half dead evidently from the action of the flood waters on its roots. These trees seemed to have lingered on for the ten years, dying by degrees ; and when I crossed the lake in 1874 the trees that I saw on landing on the west side looked then as if they had been dead for years. It is obvious then that the 1874 flood was, but little if at all, higher than the previous one, and we know certainly that there was no flood between 1823 and 1874, that at all approached these. This view is at variance with that of some persons residing near the lake, who think that all the trees were killed in 1871 ; but the evidence is conclusive that there have been dead trees round the lake ever since it was discovered, they are constantly mentioned by the surveyors who went at various times to the lake ; by Sir Thomas Mitchell in 1828, 1836, and by many others, and as mentioned above there were in 1823 dead trees that then looked old, and some standing in the water that had not even lost their bark. Mr. Glover also at my request in 1885 made a careful examination of the dead trees to see if they could be divided into two lots, one of which had been killed more recently than the others, but he could not do so, they all seemed to have been killed at the same time. The question as to the lasting qualities of the wood comes in here, the wood is apparently not of a durable kind ; but the water seems to preserve it in a remarkable way. As the following statement will show :—When at the lake in November, 1886, Mr. Glover showed me a stake 4 ft. long, that he had pulled out of the water so that it might not stake his boat, he had seen the top of it appear as the water dried up, and waited until he could pull it out of the water. I examined it and found that it had been a piece of a sapling sharpened to a point for driving into the bed of the lake, the cuts had been made with a sharp axe, and were just as sharp at the corners as if made the day before, and the wood when cut was perfectly sound all along the stake, but it was considerably cut away by the action of the waves. Now the lake has not been so low as at present, since 1870, and this stake cannot have been put in since ; it must then have been at least fifteen years in its place and presented no sign of decay. In fact the water seems to preserve the wood, and it is not surprising that trees last so long when killed by the rise of the water.

In the following abstract of the history of lake levels I have endeavoured to give the facts as concisely as possible. It will be seen in the diagram drawn from these that the rise in 1816 is shaded, this was done to indicate that it is assumed from the floods in the Hawkesbury River in 1816 that the lake rose suddenly that year. The inclination of the lake bottom is useful in many cases, for instance, in 1832 Surveyor Hoddle surveyed some land at the south end of the lake, and in his plan shows the then water-line very clearly. Three years later, that is in 1835, he went there again, and in his plan shows the lake margin 6 chains within the previous one. Now where the inclination is 10·28 in 60 chains, it is 1 foot in 6 chains, and therefore 1835 was 1 foot lower than 1832.

1816.—Very heavy floods occurred in the Hawkesbury in 1816 after a drought of three years' continuance. It was very wet in 1817, and a still higher flood swept the Hawkesbury in March this year. In 1818 it was rather dry, but 1819 brought two great floods in February. There were more floods in March; again in June, 1820, one of the greatest floods ever known in the Hunter this year.

1818.—May, 1818, the blacks told Dr. Throsby's exploring party when near Lake George that there was a great body of water in it.

1820.—When seen by the Governor in October, 1820, Lake George was a splendid sheet of water.

1821.—Mr. J. R. Styles saw the lake from Governor's Hill, it was a magnificent sheet of water reaching nearly to the town of Collector.

1823.—From what the blacks told him, Mr. H. Hall thought Lake George was at its highest flood in June, 1823.

1824.—Messrs. Hovel and Hume's Overland Journal estimates the lake as 20 miles long.

1824.—Mr. H. Hall (Climate) there were some dead trees in the margin of the lake this year that had not then lost their bark, while there were other trees farther into the lake that looked as if they had been dead for years; level of water probably about same as 1823. As the water in 1874 certainly went as high up as any of the dead trees, and actually killed a few more, it would seem to be more than likely that the water was as high in 1823 as in 1874.

1825.—There was no rise this year in Lake Bathurst, probably none in Lake George.

1827.—Mr. Kenny says the lake was not so deep as in 1876 by 3 feet; 18 ft. 6 in. deep.

1828.—The lake was surveyed in August, 1828, by Mr. Dixson, Government surveyor, and found to be 15 miles long, which is its actual length by railway marked trees now, January,

1887, so that in 1828 it was at same level as January, 1887. Mr. Dixson's survey shows that when Sir Thomas Mitchell said the lake was 17 miles long, he was only guessing at it, and the recent surveys show that the extreme length in 1874 flood was 16 miles.

1832.—Hoddle's surveyed margin of the lake in August, 1832, seems to be exactly the same as that of January, 1887; water was therefore 9 ft. deep, in deepest part of the lake.

1834.—Mr. John King says, "in 1834 there was a road along the western side of Lake George from Bungendore to Collector," at present time, January, 1887, this old road is just uncovered and wheel tracks that must have been made before 1870, when the lake rose and covered them, look quite sharply cut, as if made a few days since, the lake is now 9 ft. deep, and must have been 8 or 9 feet deep in 1834.

1835.—Hoddle again surveyed the margin of the lake in 1835, makes it at the south end 6 chains within the 1832 line; but 6 chains by Mr. Glover's levelling is shown to be equal to a fall of 1 foot, so that Lake George in 1835 was 1 foot lower than in 1832, or 8 feet deep.

1835.—Mr. F. Cooper (Climate). This year the water was nearly up to the standing timber.

1836.—Sir Thomas Mitchell's statement that the lake was a grassy meadow this year must be taken to apply only to the parts then dry. For Hoddle's survey shows us that in 1835, it was only 1 foot lower than in 1832, and it was then as high as in January, 1887, so that in 1836 it must have been 7 or 8 feet deep in the deepest part.

1837.—Mr. Powel (Climate) says the lake was rapidly drying up this year.

1838 and 1839.—Mr. A. Chisholm there can be no doubt that in these years Lake George was dry. Mr. W. Davis says (Climate) the lake was dry enough in 1839 to drive a team across the middle of it. But in October this year there were considerable floods, which filled Tarrago lagoon, and must have put water into the lake. (See Mr. Kenny's letter as to two swamps.) Mr. John King (1838 and 1839) : The whole surface of the lake bed was dry and firm.

1840.—*Goulburn Herald.*—The depth of the lake in 1840 did not exceed 3 or 4 feet, this rise was probably due to the flood in October, 1839.

1842.—*Goulburn Herald.*—The lake was dry this year, excepting lagoons. Mr. Kenny says the water was 3 feet deep in 1842.

1843.—Mr. Massey (Climate) says the lake was partly dry this year.

1845.—Mr. H. Hall (Climate). This year I drove more than once from Geary's Gap to Kenny's Point, *i.e.*, the centre of the lake, without going through any water.

1846 and 1847.—Mr. Kenny says Lake George dried up completely in these years, and remained dry until 1850. Mr. F. Cooper also says (Climate) Lake George was perfectly dry in 1848 and 1849.

1850.—Mr. Kenny says there was a little shallow water in the lake in 1850, about one-sixth of its area was covered.

1852.—Mr. Kenny says in the winter and spring of 1852 Lake George filled up to seven-eighths of its size in 1876, and was 11 feet deep in deepest part.

1855 to 1864.—Mr. M. M. Carter says from 1855 to 1864 the northern part of the lake was dry, and used as a cattle run, and I had 10 acres of wheat on it, where now, 1876, the water is 15 feet deep.

1855.—Mr. Dyce,—"During 1855 the lake extended from Currendooly Point to Kenny's Point." This would make it from 4 to 5 feet deep.

1860.—I have no direct record of the height of Lake George in 1860, but the year was the wettest ever known in Sydney, and very wet about Lake George, 40·32 in Goulburn where the average is 25 inches. The lake, however, does not seem to have risen much by the survey next year.

1861.—J. B. Thompson's survey, 31st May, 1861 shows that the waterline then was 600 feet from high-water mark, on the west side the lake falls about 20 feet from high-water mark, 600 feet out, which would make the depth in 1861 in deepest part 4 ft. 6 in.

In January, 1885, Mr. Glover levelled and sounded on the west side about Douglas house where the lake gauge is, and found that in 100 feet from 1874 level to then level there was a fall of 12 feet ; 40 feet into the water a fall of 2 feet, in the next 140 feet another 2 feet, and in the next 320 feet about 4 feet, making in all a fall of 20 feet in 600 feet.

1863.—The lake margin by survey was 2½ miles within the January, 1887, line ; and, therefore, taking Mr. Glover's inclination of the bed of lake 4·5 feet, below the January, 1887, level 4 ft. 6 in. deep.

1864.—The *Goulburn Herald* says that in 1864 Lake George filled up by the heavy rains, and was in 1865 17 feet deep.

1865 to 1868.—Lake George gradually falling.

1868.—Mr. A. Chisholm says in December, 1868, Lake George was about 10 miles long. This would be about 7 feet deep, by Mr. Glover's section of the lake.

1869.—The early levelling on the base line shows that the lake was then 6 feet deep.

1870.—Mr. Chisholm states that in January, 1870, he rode on dry land across the lake from Jones' point, and 30th June, 1877,

sounded in the same place and found 14 feet of water ; and in the deepest part of the lake found 21 feet water, so that lake must have been 7 feet deep in January, 1870.
Mr. Kenny says in April, 1870, the lake was 7 feet deep.
In September, 1870, levels were taken at the base line which show that the lake was then 15 feet 8 inches deep.

1871.—In August, 1871, the levels taken at the base line showed that the water was 19 feet deep.

1874.—The highest point in the flood in Lake George was reached about 1st November, 1874. Mr. Chisholm states that from January, 1870, to 1st November, 1874, the lake rose 17 feet 6 inches, and that in January, 1870, the water in Cooper's Bay was 7 feet deep, and therefore 24 feet 6 inches deep at greatest flood. It will be seen in 1885 note that my measures make the depth of the lake then 23 feet 10 inches a difference which is not accounted for, unless the method of sounding was different.

1876.—Writing on 3rd July, 1876, Mr. Chisholm says, "Judging from the experience of the last three or four years, the evaporation has equalled the amount of water carried into the lake. There are large gum trees, green a few years since, now standing in the water dead, evidently killed by the rise of the water. From this I should infer that the lake is higher now than it has been for at least 100 years, because these large trees must have taken that time to grow."
During 1876 winter the lake has been at a standstill ; we have had very moderate rains and nothing approaching a flood.
Again, on 30th April, 1876, the lake had fallen 2 feet 9 inches below its highest point.
In January, 1876, the base line levels make Lake George 21 feet 6 inches deep.

1877.—On 30th April, 1877, Mr. Chisholm again measured the lake and found it 3 feet 11 inches below highest flood. On 30th June he sounded Cooper's Bay, and the deepest water was 21 feet.

1878.—On 1st January, 1878, Mr. Chisholm again measured the lake and found it 4 feet 7 inches below highest flood. On the 10th of June Mr. Mountain, railway surveyor, made the lake water 5 feet 6 inches below highest flood mark, and 2,225 feet above sea level.

1883.—In March, 1883, Mr. Glover visited Lake George and made a mark on the rocks, at Cooper's, at the height of the water. Again visiting the place in January, 1887, he found the mark 5 feet above the water, which would make the lake then 14 feet deep.

1885.—18th February, 1885, lake register started, lake level found to be 11 ft. 11 in. below 1874 flood, and the lake 12 feet deep, at deepest place.

1886.—Lake register shows a fall to 31st December, of 19 inches. Lake 10 feet 5 inches deep.

1887.—9th January, 1887, lake 9 feet deep, by Mr. Glover's sounding, having fallen by register 1 feet 5 inches.

Particulars of these recent measures will be found in an earlier page.

For the valuable map of Lake George which accompanies this paper I am indebted to the Surveyor-General, and to Mr. Furber, for the very great trouble he has taken to search out every available particular about the lake to be found in old surveys. The map is carefully made to scale, and wherever possible it shows the waterline from the old surveys, points in the history; which are of very great importance because of their accuracy, such soundings as we have are also shown, it is worthy of note that the lake is smaller than has been frequently stated authoritatively. It certainly never was 20 miles long since white men have known it, and probably not for thousands of years. Although at some distant period it must have been much more than 20 miles long, with a depth at least double of our greatest record. The proof of this is to be found in the gravel thrown up by it, the extent of flat land at both ends, and the unmistakable relics of great floods.

The section of part of the base line showing the various water levels and dates has been made from all the available data, and is convenient for reference, showing the relation between the water at various times and a fixed point, which is the southern terminal of the base line. I have, in the absence of complete sounding of the lake, been obliged to assume that the deepest point found by Mr. Glover is the bottom of the lake; but there can be little doubt that this is so, and in any case the real datum is the base terminal. Mr. Glover's levelling and sounding are shown in the section of the lake, but it must be borne in mind that the sounding extended 1 mile into each end of the lake, and about 1 mile in the middle. The lake bed is, however, so even in its inclination that the section may be taken as correct.

Mr. Licensed-Surveyor T. Russell says, "In August, 1871, I went with Mr. Surveyor Betts frequently about Lake George in a boat marking the trig. stations on its sides, and we took soundings all about the lake with a view of finding the deepest part of it; the central parts varied in depth from 16 to 19 feet; 19 feet was the deepest place we could find after sounding it nearly all over. I was surprised at this, for I had the impression that it was much deeper."

This work shows the necessity for complete soundings of the

lake ; but I have not time now to wait for them, the section also should be carried north and south to the possible limits of the lake which for the same reason must wait completion.

The letters, &c., which follow contain many valuable statements, and throw light on several points. One of the early difficulties in collecting data was that the statements were often quite contradictory, one saying the lake was dry at a certain time while the other affirmed that the water was 3 or 4 feet deep. Mr. Kenny shows us that both may be true, *i.e.*, that there might be a dry road over the lake whilst there were swamps on either side of it 3 or 4 feet deep.

Mr. Kenny, 18th August, says : Lake might be dry across from a point 1 mile N.W. of Kenny's Point to Geary's Gap, while there would still be a considerable sheet of water towards Collector about 4 feet deep and another towards Bungendore of the same depth, neither of which might be seen owing to Fat Hen and other plants growing on the dry part. This may account for some of the statements making it appear that the lake bed could be crossed here dry shod, whilst others asserted that it was not dry.

Mr. Mowle's letter explains the muddy waterhole so often mentioned ; it was a waterhole at the end of the swamp at the Collector end of the lake, and was used by shepherds and teamsters.

In November, 1881, Mr. S. Ranger began to observe the rate of fall in the water of Lake George, and found that in twenty-two weeks it had fallen 22 inches. Probably this was a very dry time, as this rate is seldom reached now ; about 20 inches in a year is the usual rate of fall. Mr. Ranger also says that in March, 1884, he tried with a level and found that the lake had fallen 11 feet 8 inches below the highest mark.

Mr. J. Matthews, under date Lake George Base Line, 22nd April, 1870, the men have been three weeks removing logs from under and on top of bridge. The creek rose 2 feet higher than in previous rains.

Again, 28th April : We have had the highest flood known for twenty years. It rose 2 feet into Mr. Osborne's house (old Currandooley), washed away the base line, bridge, and put 2 feet of water on to the lower part of the base line.

Again, 14th May, 1870, the lake is now 6 feet above its ordinary level.

Probably water in Butmaroo Creek in diagram was considered at ordinary level, for it is 6 feet below the bridge. He also says the *North* end of the line is under water. Now by the diagram that would make the water 6 inches over the bridge at Butmaroo Creek. As Mr. Matthews' statements would not depend upon levelling, but only what he saw when going about, there seems little doubt that the water shown in Butmaroo Creek was the level of the lake when the line was laid out ; up to August, 1870, therefore, the lake had risen 10 feet.

Extract from the Report of the Commissioner of Enquiry) John Thomas Bigge) into the condition of New South Wales.

In his report on Agriculture, page 7, he says, date end of October, 1820, "Lake Bathurst is about 12 miles round. Mr. Meehan, Deputy Surveyor General, who visited the lake (Bathurst) in 1818, is of opinion that it had much increased in size in the interval"; 1819 wet, three floods in Hawkesbury this year. Several trees and shrubs in the margin of the lake appeared to have been lately surrounded with water, the colour of which was strongly tinged with ochreous clay of the shores. "On approaching the N.E. shore of Lake George the swampy meadows are of greater extent, and reach to the margin of the lake, where they are separated by rocky projections of sandstone. The extent of the lake from N. to S. is nearly 18 miles and its main breadth is from 5 to 7 miles. Dead trees *were observed in it to a considerable distance from its present shores* and the person who had discovered it in the month of August preceding, that is 1818, seemed impressed with the belief that the expanse of water had considerably increased."

The water itself had been represented to be salt, but it was found by experiment to be remarkably soft though turbid. The lake is bounded on the west by a table chain of rocky hills elevated from 800 to 1,500 feet above its level, and it was from one of these that Mr. Oxley thought he descried a mountainous chain to the W. and N.W. of Bateman's Bay, on the eastern coast of New South Wales, distant about 40 miles.

Page 8. He mentions that on the journey from Bathurst to Lake Bathurst he passed many swampy places.

Page 9. The elevation of the country in the Western side of the Blue Mountains is strongly marked by the rapidity and fullness of the streams of water and their abundance in every direction.

J. B. Thompson's survey, 31st May, 1861, No. 61/31, shows the marked edge of the lake 500 to 600 feet from edge of timber on west side along the road from Gundaroo to Collector.

J. F. Mann's plan, 29th March, 1856, shows present line of water 4 chains south of high-water mark at south-west corner of Francis Cooper's 45 acres, block 24.

Mr. Arnheim's survey, 2nd March, 1863, shows edge of lake water, then about 300 to 400 feet from Ondyong Point, and curving thence northwards 40 chains ½ mile at its extreme north point.

N.S.W. Gazetteer.—Editor's address is dated March, 1866. Article on Lake George was probably written in 1865, and it refers to the rains of last year filling up the lake, that no doubt was the wet year 1864; he says it is now (1865) higher than ever, and 17 feet deep in places.

Hoddle's survey, 10th July, 1835.—Water 10 chains from high-water mark; his high-water mark is above the dead trees, 1 mile north of Butmaroo Creek.

The Honorable P. G. King says, under date 6th March, 1885: "Sir Terence Aubrey Murray, at one time when the Murrumbidgee was a chain of waterholes, drained one of the holes at Yarrowlumla, near Yass, caught the fish and carried them (Murray cod) in a water cart to his creek at Winderradeen, where they multiplied rapidly and became too fat to eat. I believe they have remained ever since in the lake, and I think the fish were put in before 1848. Mr. S. M. Mowle thinks the fish were put in between 1845 and 1846. I am unable to fix the date, but the fish are still there, but are now very difficult to catch. Still one or more fishermen make a living by catching them.

If the fish were put into the lake on or before 1848, the lake cannot have been quite dry since as it is stated to have been."

Mr. A. Chisholm, of Winderradeen, under date 2nd January, 1878, says: "The following few facts about Lake George may be interesting to you, and are worth recording. You may rely upon them as being correct:—

1. The highest water mark known was attained in the winter of 1874 (say about 1st November, 1874).
2. At the end of the summer of 1876 (30th April) it had fallen 2 feet 9 inches below the highest mark. It gained 9 inches during the winter and spring of 1876.
3. At the end of the summer of 1877 it had fallen 3 feet 11 inches below the 1874 level. During the winter of 1877 (say up to 1st November) it gained 6 inches, beginning this present summer at 3 feet 5 inches below highest mark.
4. During this summer so far it has fallen 14 inches, making the present level 4 feet 7 inches below highest mark on 1st January, 1874.
5. In January, 1870, I rode across the northern bay of the lake just heading the water. On 30th June, 1877, I sounded across the same line as near as I could guess and found 14 feet of water. The level was then

3 feet 6 inches below 1874 mark ; so that from January, 1870, to end of the winter in 1874, the lake must have risen 17 feet 6 inches.

6. On the same date (30th June, 1877,) I sounded all over Cooper's Bay and along Cooper's shore, and could find no greater depth than 21 feet. This proves that previous to 1870 the depth generally over that part of the lake could have been only about 7 feet.

"The (*see* Mr. Kenny's letter) lake may be deep further south along the Currendooley shore, but from what I can learn I don't think there is much difference.

"I am inclined to think that most of what has been said about the lake in past years has been simply guesswork and tradition. These are facts verified by actual measurement."

Mr. A. Chisholm, of Winderradeen, under date 19th June, 1878, says : "Surveyors are at present engaged in making a trial survey for a railway line to Maneroo. Mr. Mountain, the one who has charge of the portion from Bredalbane to Bungendore, has got as far as Lake George, and he tells me that the present level of the water is, or was on 10th June, 2,225 feet above the sea. This he has ascertained by actual levelling from Bredalbane platform. On the same date the lake had fallen 5 feet 6 inches below the highest mark of 1874."

Mr. J. F. Kenny, of Kenny's Point, says, under date, 3rd August, 1876 : "Any information I can give about the lake, I fear will not be very valuable for meteorological purposes, but such as it is I have much pleasure in placing it at your service. The present dimensions of the lake may be fairly estimated as follows : —Length 20 miles, average breadth 7 miles, average depth 20 feet (deepest part would be then 22 feet, *see* diagram 1876, and therefore Mr. Kenny's average of depth is 2 feet less than deepest. I state this for comparison). In 1826-7 the length and breadth were nearly the same, but the depth was about 3 feet less, at that time it had receded to the extent of about 1 foot in depth, and continued to recede or dry up until it became nearly dry, or until there was only one-fifth of the present area covered with water, at which stage it arrived in 1837. With slight fluctuations it continued in this state until 1840-41, when it became wholly dry. 1842 or 1843, I am not sure which, there was sufficient rain to cover it with water to about one-fourth of its present size, but the depth was in no place more than 3 feet. It dried up again completely 1846-47, and remained dry until 1850, when about one-sixth of the present area was covered with water, the depth very trifling. There was little increase in this until 1852, during the winter and spring of which year the lake became filled to fully seven-eighths of its present area, but the depth did not exceed an average of 9 feet (11 feet in deepest) ; since then it

has not been dry, though it fluctuated very much, two-thirds dry 1858-59 and 1860. 1861 to 1866 slightly increasing until it attained about half its present area. 1866-67-68 drying until it was not more than 2 feet in average depth (4 feet deepest), and one-third of its present area, increasing slightly until April, 1870, when the average depth was about 5 feet (7 feet at deepest), and the area about 15 miles by 6. From that time, viz., April, 1870, it continued to increase rapidly—that is for Lake George —until August, 1874, when it attained about 6 inches higher than its present level, with but very little less than its present area. It then began to recede, and between that time and April of 1875 it had evaporated to the extent of 2 feet 9 inches in depth; but by October in the same year the water had increased to a height of 2 feet 6 inches higher, or above any mark attained since the country was inhabited by white men; or, to speak more accurately, since the lake was known to them. It is now down more than 3 feet from the highest mark. I am sorry I cannot approach nearer to accuracy; but if the information as here given is of any use it may be relied upon, as far as it goes, as being correct and authentic."

Mr. J. F. Kenny, of Kenny's Point, says, under date 18th August, 1876: "I do not think there is any disparity between my statement and that of Sir T. Mitchell, viz., that the lake was in October, 1836 'a grassy meadow.' As the lake receded, a herb, known familiarly as Fat-hen, and other salsolaceous herbs of a creeping habit sprung up, the former in some places attaining a height of 6 feet, which to a casual observer on a level with the lake would give the appearance of 'a grassy meadow' some years previous to that time. I have no hesitation in saying that Mr. Styles was mistaken as to the lake being dry in 1832, though it may have been dry across from about a mile north-west of Kenny's Point to a point known as Geary's Gap, over which the road to Gundaroo, &c., passes. It would be dry here, while there would be a considerable sheet of water from 3 to 4 feet deep in the direction of Collector, and a much larger sheet of water of about the same depth in the direction of Bungendore, neither of which would be visible to the traveller across the lake in consequence of the herbage mentioned above. The lake could not properly be called a grassy meadow until about two years previously to the time when it began to fill in 1852, at which time only could it have been said to be fairly *grassed* over. Mr. Styles had a property at Gundaroo, and it is probable that visiting that place from his Bungonia property, he crossed the lake from Kenny's Point and received the impression that it was wholly dry. There can be no doubt the survey in 1828 was correct, but as my statement of the length and breadth is only an estimate, no conclusion can be drawn from any disparity between that and the

survey. I may be wrong in my estimate. In conclusion I may state that indisputable evidence exists to show that the lake ages ago covered at least twice its present area, without being perhaps more than double its present depth, and with a continuance of wet seasons there is nothing to prevent it from doing so again. It would be difficult to find clearer and more interesting evidence than is shown by the lake and its vicinity, that this has for countless ages been a land of flood and droughts."

Mr. John King, Mairburn, Metung, Victoria, 16th March, 1885, says: "With reference to Lake George, my earliest days in the bush were spent first at one end and then at the other of the lake, between the years 1834 and 1841. To be brief I will first notice the remarks I find in your book. 'The old woman who saw it covered with trees must have meant some logs washed on to the surface, as I never saw a stump or root in what might be called the bed of the lake.' As *to the chain of ponds* I always wondered at its singular level surface and absence of anything like a hole or pond; there were of course holes at the very edge of the lake at the end of Bungendore Creek. As also at several other creeks but the lake proper had *no holes.*

"Sir Thomas Mitchell speaks of a grassy plain in 1836, but the grass only grew at the north end and extended only about 3 miles towards the south, all the rest was bare, and in summer bunches of Fat-hen extending all over the dry parts. There was certainly a strip of grass along the western side about half-a-mile wide, which was probably what Sir T. Mitchell saw.

"Bungey's Hut or Muddy Water must surely mean one of the holes close to the edge of the lake. I never saw anything that could be so described in the lake itself.

"Mr. C. Thomas's statement that 'the lake was partly full in 1840, the depth not exceeding 3 or 4 feet' must also be a mistake in the sense that all the lake was partly full. There may have been a strip of water on the east side, as that side was always the last part of the lake to be dried up. Either it was the lowest ground or the subsoil was more retentive.

"I first visited Lake George with my father, late Admiral P. P. King, in 1834, and the water on the eastern side seemed to be about 4 miles wide, the depth we could not ascertain. The south western side was dry enough to admit of vehicles passing from Collector to Geary's Gap, also to Bungendore. Both north and south ends were also dry, and formed good pasture land for cattle. The water gradually receded from 1834 to 1838-39 when the whole surface of the lake bed was dry and firm: no sign of waterholes or swamps, as I have traversed it from end to end repeatedly. The lofty dead gums standing on the edges of the lake, and on a few projecting points, favouring the idea that the lake had been *low enough, long enough,* to allow the trees to grow

on the banks, but the entire absence of tree, stump, or root, *in the bed of the lake* conveyed the idea that it was never dry long enough to admit the growth of timber. As it required several dry seasons to exhaust Lake George, I cannot suppose that the subsoil was at all porous, indeed quite the opposite, as it was a long time drying it up, and apparently by evaporation. I do not think the state of Lake George will determine the rainfall of surrounding country as compared with years passed by. In former times both timber and grass helped to retain the rain as it fell on the ground, and there might be a good average of rainfall during the year without its swelling the creeks or reaching the lake, but in years when the rain fell heavily and had no time to soak in the lake might be considerable smaller without more than an average rainfall.

"There is also another change constantly at work which may alter the condition of such places as Lake George, as cattle tracks are formed in nearly every gully. These become small drains and at last work deep cuts thinly exposing springs which start running. I am told Bungendore Creek is thus altered and now runs a strong stream, at times, towards the lake. Between 1834 and 1841 I never knew even a flood pass Bungendore township at least 3 miles from the lake.

"In the Bega country, near Twofold Bay, deep rivers became sanded up by the washing from the hills and gullies of the soil, the cattle tracks having first become small drains, the absence of grass also baring the ground. I have not visited Lake George for the last twenty years, but I am told that the surrounding country is much altered, trees dead; but whether this alteration will raise or lower water in Lake George remains to be seen, but this difference should be taken into account when the present years are compared with the past."

Mr. S. M. Mowle, under date 7th May, 1885, says: "I have had much pleasure in reading your account of Lake George, a place with which I was familiar during the period between 1838 and 1852. I first rode along the dry bed of Lake George in July, 1838, with Sir Terence Murray, with whom I went on a holiday trip from school to the Queanbeyan district. I do not think there was any water upon it then, except perhaps, at Kenny's or Stonewall Point, on the east side of the lake, where it trends away to its greatest width 12 miles, and not 5 miles as stated. At the northern end of the lake there is a lagoon cut off from the lake by a ridge which I now suppose to be of gravel, but I never examined it. It is a mistake to think that this lagoon always contained water, for I never saw any upon it, and frequently crossed it to go up the range to Gundaroo, by a track we used to call, 'the marked tree line.' Sir Terence Murray was always anxious to have water in this lagoon, and he cut a race for this purpose from the chain of waterholes which pass the

cottage he built, now occupied by Mr. Beit. The only water at the northern end of the lake, was a waterhole at the termination of the swamp, called 'Agamatong,' but familiarly known by teamsters and shepherds as the 'muddy waterhole.' Dead trees of large size stood on the side of the lake. We went up the range at Geary's Gap, at about 12 miles south, towards Bungendore. This road is now not used, I was at this place in January last, but just before the 7 inches of rain fell, so I could not ascertain whether that effected the lake. It is a matter of speculation whether the lake will ever dry up again. It was pretty full in about 1828, when, I think, Sir Terence Murray first went there, and it was certainly dry in 1838. It filled in 1852, when I had left the district, and has continued nearly full since. Cod and perch were both sent to the pond at Mr. Beit's cottage, by Sir Terence, but the latter did not increase. They were caught by draining a pond in the Queanbeyan River, and were transported in a water cart. I have over and over again seen the cattle miles off on the level plain of the lake bed, as if they were walking in the air. Mr. John King, whom I knew very well, lived at 'Agamatong' a cottage named after the water holes as above. I forgot to say that the race I have spoken of was always a dry one, and that the lagoon did not fill; we had no rain in those days. I saw the Murrumbidgee in 1838 a chain of ponds above the junction of the Colter, below this little stream it ran fairly."

Mr. Alexander Dyce, of Gundaroo, under date 1st June, 1884, says: "From 1838 until 1842 the lake was used as grazing plain by numerous stock-owners. Messrs. Packer, Dyce, and Guise, had herds of cattle there. The springs of 1842 and 1843 were wet, accompanied with heavy falls of snow, which had the effect as Mr. Kenny says of covering a small portion of the lake on the eastern or deepest part. From 1843 until 1850 the lake water diminished, and in 1851 I walked across the bed of the lake from Geary's Gap to Kenny's Point, and this year there was not a single drop of water on the lake, even the (*see* Mr. Mowle's letter) muddy waterhole was dry, which was seldom the case. Mr. Kenny's account of 1852 is quite correct. 1853 gradually diminishing in size; 1854, fluctuating, that is, increasing in the autumn and winter, and drying considerably in the summer; 1855, a dry year, consequently the lake dried up considerably; 1856, the lake was about half covered; 1857, that is, from the Currendooly Point to Kenny's Point, and stretching out about half way across towards Geary's Gap, when driven by the east wind. The 'Flooded Gum,' which grows upon the shores of the lake is a very quick growing tree, and does not appear to live after the land around becomes submerged."

Mr. W. H. Glover, under date 4th May, 1885, says: "I have made a careful examination of the dead trees between the water and the 1871 level, and cannot detect any difference as to time of dying, as at some places the trees nearest the water are most decayed, and close by just the reverse occurs, this is noticeable in many places. From the appearance I fancy they were all killed at about the same time."

[Three diagrams.]

LAKE GEORGE

FROM VARIOUS SURVEYS

1828 TO 1871

Scale of Chains

0 20 40 60 80 160 240 320 400 480

LAGOON

SAND RIDGE

COUNTY BOUNDARY T.S.

1874 Flood

Bells 1811

B

Aug 1828 Dixon

Jany 1887 Russell

Jones's Pt

Jany 1870 Chisholm

Jany 1867 Chisholm

March 1863 Arnheim

T.S. 1863

Onslyong Pt

1842 Kenny

GEORGE'S L. 1830

1856 & 1857 Dyce

Kenny's Pt

Village Res.

COOPER T.S.

GROSE'S HILL T.S.

1887 BY GLOVE & 1877 by Chisholm

Rocky Pt

GEARY'S GAP T.S.

TAYLOR'S CREEK

Currendooly Point

E. End of Old Base Line

Silver Wattle Point T.S.

PORROROMBA T.S. 2504

SCHOFIELD T.S. 2503 APPROX.

SMALLEY T.S. 2852 APPROX.

GAUGE ON JETTY

Pillar at North End of Base Line

B.M. 17.50 ft. above level of Lake 2nd Feby 1876

2262 ft. above Sea Level

OSBORNE T.S. 2936

Old Base Line

New Base Line

BUTMAROO OR DEEP CREEK

SWAMPY FLAT

TURALLO CREEK

S. End of Old Base Line

Pillar at South End of Base Line

B.M. 17.21 ft. above level of Lake 28th Jany 1876.

2274 ft. above Sea Level

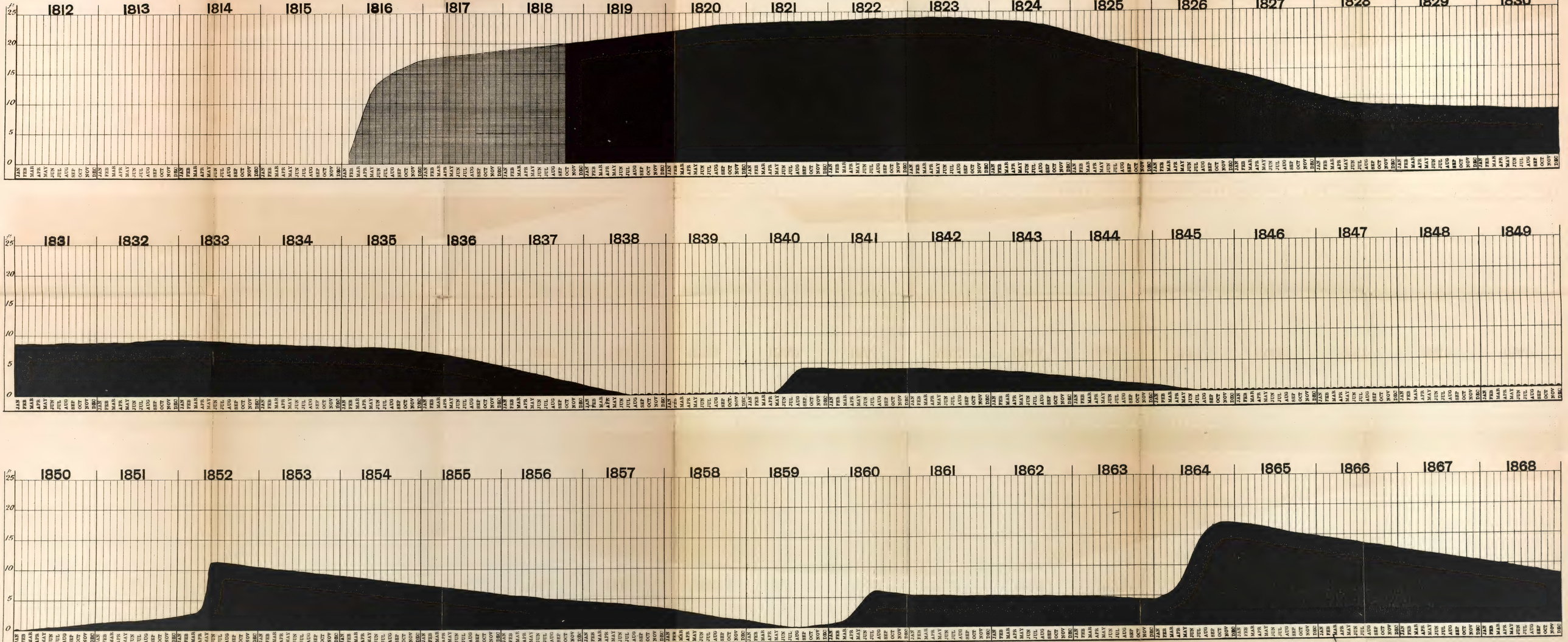
BUNGENDORE

TURALLO T.S. 3032

Compiled in the Surveyor General's Office, 1887.

5h 13-87

FLOODS IN LAKE GEORGE.

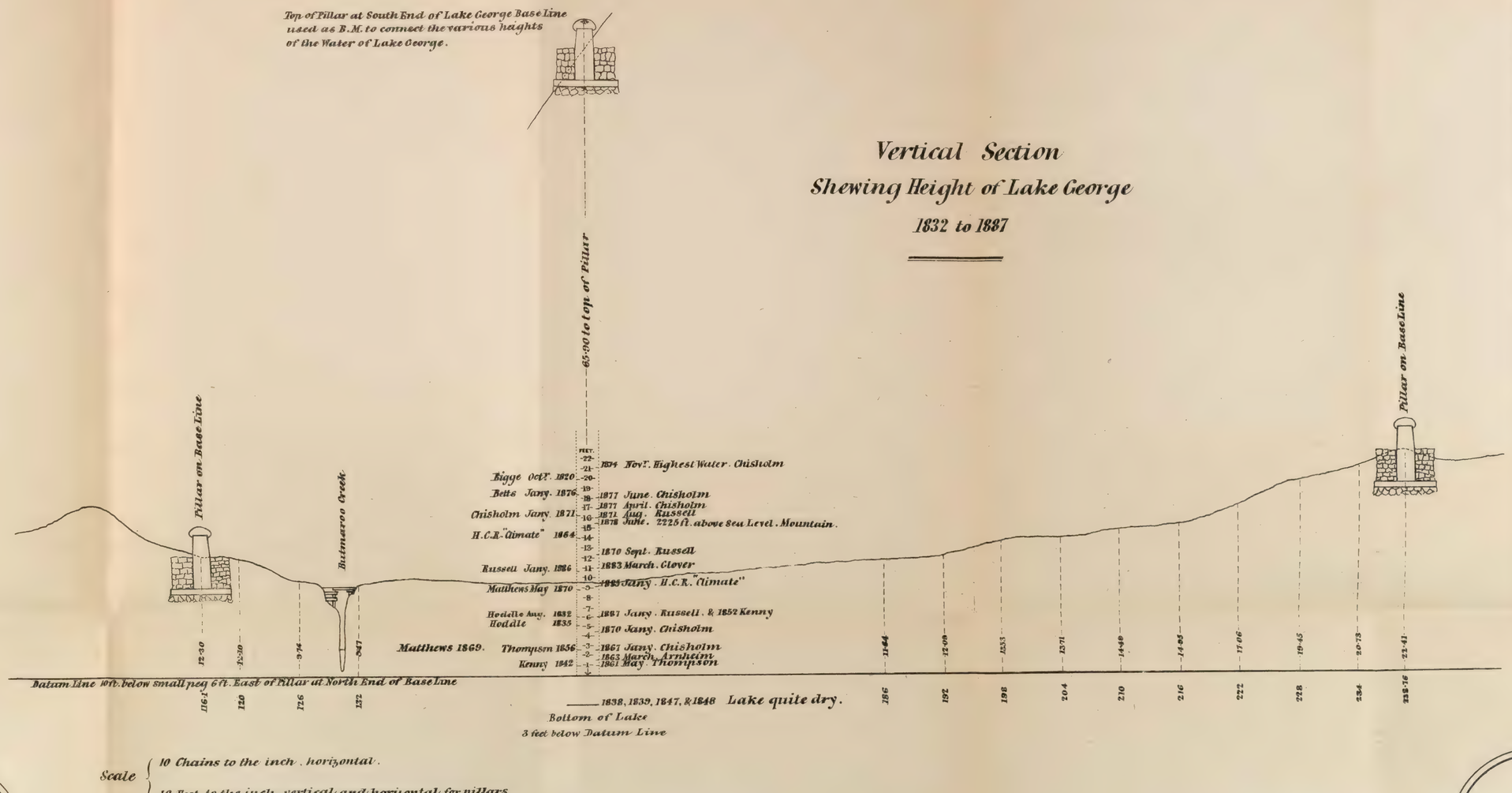


(5h13—67)

PHOTO-LITHOGRAPHED AT THE GOVT. PRINTING OFFICE,
SYDNEY, NEW SOUTH WALES.

Diagram for M^r Russell's paper on Floods in Lake George

Vertical Section
Shewing Height of Lake George
1832 to 1887



Scale { 10 Chains to the inch, horizontal.
10 Feet to the inch, vertical, and horizontal for pillars

Compiled Jany. 1887.

PHOTO-LITHOGRAPHED AT THE GOVT. PRINTING OFFICE,
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SECTION THROUGH LAKE GEORGE AT AB

PHOTO-LITHOGRAPHED AT THE GOVT. PRINTING OFFICE,
SYDNEY, NEW SOUTH WALES.

The Strength and Elasticity of Ironbark Timber as applied to Works of Construction.

By W. H. Warren, A.M.I.C.E., Professor of Engineering, University of Sydney.

[*Read before the Royal Society of N.S.W., 1st December, 1886.*]

It is proposed in the following paper to consider the results of some experiments made on ironbark timber, and to compare the relative merits of two types of timber viaducts used in New South Wales and Victoria with the aid of these results, and of those derived from direct experiments on model structures one-eighth the full size of the structure they represent.

These experiments have been made in the Engineering Laboratory of the University of Sydney by means of the testing machine. The published data on this subject consists of the following :—

1. Experiments on the transverse strength and stiffness of beams of Colonial timber 2 in. wide by 2 in. deep when tested on supports 4 ft. apart, made at the Sydney Mint, by Col. Ward and Mr. Trickett, in 1861.

2. An experiment made by Mr. John Whitton, Engineer-in-Chief for Railways, on a beam of ironbark 12 in. by 12 in., when tested on supports 26 ft. apart.

3. An experiment made on a similar piece of ironbark $12\frac{1}{4}$ in. by $12\frac{1}{4}$ in., when tested on supports 28 ft. 6 in. apart, by the Railway Bridges Inquiry Commission.

4. Some experiments made by Mr. Thomas Laslett, Timber Inspector to the Admiralty, in 1875, and recorded by D. K. Clark in his "Rules, Tables, and Data for Mechanical Engineers."

The experiments made at the Sydney Mint, in 1861, furnish exact data on the strength of simple beams of small scantling, and when these are compared with the experiments made by Mr. John Whitton, and those of the Railway Bridges Inquiry Commission, it is seen that with a slight modification of the co-efficient of strength or modulus of rupture as the case may be, it will be safe to use these results in determining the strength of beams of larger scantling. The experiments made by Mr. Laslett on the transverse strength of ironbark beams of small scantling give results almost exactly the same as those obtained in the best of the Mint experiments; but his experiments on the tensile resistance of ironbark appear to have been inaccurate. This matter will be again referred to.

So far then, the only data we possess on the strength of Colonial timber (with the exception of ironbark) is its transverse strength when used as beams of small scantling. Now in the application of timber to the construction of the various kinds of temporary and permanent structures, it is often necessary to know the direct resistances of the materials to direct tensile and compressive stresses. Again, in connecting pieces of timber together with bolts or wedges, we require to know the pressure that may be safely allowed upon the bearing area of the bolts or wedges. And in joints such as that between the principal rafter and main tie-beam of a roof, the resistance of the material to shearing along the grain will be developed as well as the resistances above referred to.

The data obtained by the various experimenters on transverse strength and stiffness will be first considered.

Transverse Strength. —It is well known that when a beam is subjected to transverse stress it deflects, and the upper fibres are compressed and the lower fibres extended. The intensity of stress on the extreme upper or lower layer of fibres is greater than that on any intermediate layer, and since at some intermediate layer tension must change into compression the direct stresses must vanish at this layer which is therefore called the neutral layer. And the intensity of stress on any layer above or below this layer will be proportional to its distance from the neutral layer. And the moment of resistance of any layer is the product of its area into its distance from the neutral layer into the resistance of the layer in question to the stress developed along it, and the sum of all such products is the moment of resistance of the whole section.

Let I = moment of inertia of the section with reference to an axis passing through its centre of gravity.

Let y = distance from the neutral layer to the extreme fibre.

Let f = modulus of rupture, then moment of resistance (Mt. R) $= f\frac{I}{y}$. For rectangular sections, such as those experimented upon $I = \frac{1}{12} b\ d^3$. Where b = breadth of the beam, and d = depth.

$$\therefore f\frac{I}{y} = \frac{\frac{1}{12} b\ d^3}{\frac{d}{2}} f = \frac{1}{6} b\ d^2 f$$

Now since in the record of the experiments made at the Sydney Mint a co-efficient denoted by S is used, which is calculated from the formula $S = \frac{l\ W}{4\ b\ d^2}$ and since in Molesworth's Pocket-book this co-efficient is also used for calculating the strength of timber

beams it may be as well to show the relationship between it and the modulus of rupture thus—the moment of flexure produced by a central load W on a beam resting upon supports l apart = $\frac{W\,l}{4}$ = Mt. $R = \frac{1}{6}\,b\,d^2\,f$

$$\therefore f = \frac{6\,W\,l}{4\,b\,d^2} = 6\,S$$

The modulus of rupture is therefore six times as great as this co efficient. The breaking central weight can therefore be calculated from the following formula :—

$$W = \frac{4\,b\,d^2}{6\,l} f = \frac{2}{3} \cdot \frac{b\,d^2}{l} f$$

The mean values of f for ironbark timber used in the Mint experiments are as follows:—

1. Red ironbark from Berrima, *Eucalyptus leucoxylon* $f = 18{,}306$ lb.
2. White ironbark from Berrima, *Eucalyptus crebra* $f = 17{,}136$ lb.
3. Ironbark from Albury, *Eucalyptus siderophloia* $f = 13{,}734$ lb.

In the experiments made by Mr. J. Whitton $f = 13{,}953$ lb.

In the experiments made by the Railway Bridges Inquiry Commission $f = 12{,}222$ lb.

In experiments made by the Author on specimens $3\frac{3}{4}$ in. by $1\frac{1}{2}$ in. and $3\frac{7}{8}$ in. by 2 in., tested in University machine on supports, 4 ft. apart, the mean value of $f = 15{,}000$ lb.

The specimens tested by the Author were cut from the remains of the large beam tested by the Railway Bridges Inquiry Commission, and the experiments on tension and compression, as well as those on model structures which will be referred to in this paper, have all been made on timber obtained from the sound portions of this large beam.

With regard to the higher value of the modulus of rupture obtained by the Author for the same timber when cut up into smaller scantling, it should be mentioned that the smaller specimens had the advantage of another year's seasoning.

While further experiments are desirable in order to decide the modulus of rupture for large sized scantlings of Colonial timber, the Author advises that until these are forthcoming the modulus of rupture derived from the Mint experiments be reduced 25 per cent. when applied to timber of large scantling.

Transverse Stiffness.—The stiffness of a beam or its resistance to deflection may be investigated in the following manner :—

Let r = radius of curvature.

Let M = moment of flexure.

Let I = moment of inertia.

Let E = modulus of elasticity.
Let v = deflection.

Then it can be proved that $\frac{1}{r} = \frac{M}{EI} = \frac{d^2v}{dx^2}$ nearly.

If i is the circular measure of the slope at a distance x from the origin, since $i = \tan i = \frac{dv}{dx}$ nearly.

$$\frac{d^2v}{dx^2} = \frac{M}{EI}$$

$$i = \frac{dv}{dx} = \int \frac{M}{EI}\, dx$$

$$v = \iint \frac{M}{EI}\, dx^2$$

E is a constant, and if the beam is of uniform section I will also be a constant, hence we may write

$$i = \frac{1}{EI} \int M\, dx\,; \; v = \frac{1}{EI} \iint M\, dx^2$$

In the case of a beam supported at each end and loaded in the centre as in the experiment. Assume the origin at the left hand support, then we have $M = \frac{W}{2} x$, if x is taken to left of centre of beam, and $M = \frac{W}{2}(l-x)$, when x is taken to right of centre of beam.

Therefore we obtain by integrating $\frac{1}{EI}\left(\frac{W}{2} x\right)$ the equation for the slope $i = \frac{W}{2EI} \int x\, dx = \frac{W}{2EI}\left(\frac{x^2}{2}\right) \times C$

When $x = \frac{l}{2}$ then $i = o$.

$$\therefore C = -\frac{Wl^3}{16EI}$$

$$\therefore i = \frac{W}{4EI}\left(x^2 - \frac{l^2}{4}\right)$$

$$v = \frac{W}{4EI}\left(x^2 - \frac{l^2}{4}\right) dx = \frac{W}{4EI}\left(\frac{x^3}{3} - \frac{l^2 x}{4}\right) \times C$$

When $x = o$, $v = o$. $\therefore C = o$

$\therefore v = \frac{W}{4EI}\left(\frac{x^3}{3} - \frac{l^2 x}{4}\right)$ which is equal to a maximum when $x = \frac{l}{2}$

$v = \frac{Wl^3}{48EI}$ = a maximum when $x = o$

$$\therefore = \frac{Wl}{16EI}$$

For rectangular sections we have by substituting for I its value, viz., $\frac{1}{12}\ b\ d^3$.

$$\therefore\ i = \frac{3\ W\ l^3}{4\ E\ b\ d^3} = \text{greatest slope.}$$

$$\therefore\ v = \frac{W\ l^3}{4\ E\ b\ d^3} = \text{greatest deflection.}$$

The modulus of elasticity derived from the experiments made at the Mint may be found from the formula $E = \frac{W\ l^3}{4\ v\ b\ d^3}$

The average of ten experiments gave a deflection of 1·2 inches with a weight applied at the centre of 1,437 lb.

$$\therefore\ E = \frac{1437\ \times\ 24^3}{4\ \times\ 1{\cdot}2\ \times\ 2^3} = 2{,}069{,}280\ \text{lb.}$$

In the experiments made on transverse elasticity by the Railway Bridges Inquiry Commission, the deflections were taken both by mutiplying levers and by reading a graduated staff fixed to the centre of beam with an ordinary surveyor's level. In the two experiments made by the author with specimens cut from the same beam the modulus of elasticity came out almost exactly the same as with the larger experiments made by the Railway Bridges Inquiry Commission, viz., $E = 2{,}715{,}813$ lb., which may be taken as a mean result in calculating the deflection of large beams from the formula above referred to.

The diagram of the Railway Bridges Inquiry Commission, fig. 11, and those obtained by the author, one of which is shown (*See* fig. 3), shows that the deflections are nearly proportional to th loads producing them.

Tension.—The resistance to tensile stress will now be considered. In preparing specimens for testing in tension, the author has found it necessary to considerably reduce the section along the length where the elongations are measured, and to provide ample area in the portions held by the clips in the machine, otherwise the specimen will break in the clips, instead of in the reduced portion with a stress considerably under the tensile resistance of the material. The author has obtained fairly good results from ironbark timber when the specimens had the form and dimensions shown in fig. 1 ; but the best result was obtained by turning the specimen in a lathe to the form and dimensions shown in fig. 2 here the portions held by the clips were concentric with the portions tested and the stress developed was therefore perfectly axial. The mean resistance obtained from specimens of the form shown in fig. 1, was 17,000 lb. per square inch, while the specimen shown in fig. 2 gave 20,000 lb. per square inch. In D. K Clark's "Rules, Tables, and Memoranda for Mechanical Engineers," it is stated that the tensile resistance may be calculated from the formula

$$S = \frac{W\ l}{1{\cdot}155\ b\ d}$$

Where S = the tensile resistance, and W, l, b, d, have the values given in the formula for transverse stress already referred to.

It has been shown that

$$f = \frac{6\ W\ l}{4\ b\ d^2}$$

$$\therefore\ \frac{S}{f} = \frac{1}{1{\cdot}7325} \qquad \therefore S = \frac{f}{1.7325}$$

Now f in the author's experiments = 15,000

$\therefore S$ = 865·8 lb., but the experimental result was S = 20,000 lb. per square inch.

In the experiments made by Mr. Laslett

$$f = 18{,}994{\cdot}5 \quad \therefore S = \frac{18{,}994{\cdot}5}{1{\cdot}7325} = 10{,}963$$

It appears therefore that if the specimens which gave this high value for the modulus of rupture had been prepared by turning in a lathe, and if they had been tested in such a manner that only tensile resistances could be developed the result would have exceeded 20,000 lbs. per square inch. Hence it appears that Mr. Laslett's results for tensile strength are unreliable, and moreover the formula cannot be applied to timber since the tensile resistance is greater not less than the modulus of rupture.

The difficulty experienced in making tensile tests from the tendency of the specimen to fracture at some other point than that prepared for fracture (due to the stresses developed being non-axial, or an insufficient reduction in prepared area), points to the importance of careful design in the joints of timber structures, for unless this is attended to the fracture will occur at the joint, rather than in the body of the timber. The resistance developed in the joint, due to tensile stress, will be the shearing resistance along grain, and the resistance to pressure on the bearing area of the bolts.

Tensile Elasticity.—May be found by measuring the strain produced by a given stress, thus if E = modulus of tensile elasticity. P = intensity stress per square inch ; L = length along which the elongations are measured ; and l the elongation produced by an intensity of stress P then

$$P\ :E\ ::l\ :L \qquad \therefore E = \frac{P\ L}{l}$$

The author has found from specimens shown in figs. 1 and 2 that the modulus varies with the load. In the round specimen shown in fig. 2, the elongation produce with 13,333 lb. per square inch was ·04 on a length of 10 inches, so that

$$E = \frac{13{,}333 \times 10}{\frac{4}{100}} = 3{,}333{,}900\ \text{lb.}$$

The elongations and loads producing them are shown for specimen prepared, as in fig. 1. *See* fig. 4.

Compression.—The testing of specimens in compression in the University machine is comparatively a simple matter, as it is not necessary to make any provision for fixing the ends in clips, or to reduce the section as in the case of tensile specimens.

The following tests were made :—

No.	Size of specimen.	Area of Section tested.	Ultimate resistance in pounds per square inch.
1	24 in. × 1·94 in. × 1·89 in.	3·67 square in.	8,719
2	24 ,, × 1·90 ,, × 1·69 ,,	3·21 ,,	9,034
3	18 ,, × 1·68 ,, × 1·88 ,,	3·16 ,,	9,168
4	8·35 ,, × 1·80 ,, × 1·50 ,,	2·7 ,,	10,000
5	8·35 ,, × 1·80 ,, × 1·50 ,,	2·7 ,,	9,074

Mr. Laslett found the compressive resistance to be 4 tons, or 8,960 lb. per square inch, which agrees fairly well with the above results. It will be seen that the intensity of stress producing rupture was not affected by the size of the specimen, the average of the above results gives 9,199 lb. per square inch.

Compressive Elasticity.—As in tensile elasticity the author has found that the modulus of elasticity is not constant, but decreases as the load increases. The modulus of compressive elasticity is a factor in Rankine's formula for pile driving. Referring to figs. 5 and 6, which show the compressions and loads producing them it is seen for a load of 1,869 lb. per square inch, *see* fig. 6, the compression produced was 0·00175 inches, from which $E =$ 25,630,000 lb., while with a load of 4,979 lb. per square inch, producing a compression of 0·016 inches, $E = 7{,}468{,}500$. The author has not yet made experiments on the resistance to shearing along the grain, or across the grain.

Although timber is being superseded in permanent works of construction by the use of iron and steel, there are many cases in which iron is entirely unsuitable, and where timber is the only material that will answer the purpose; moreover, where either material may be used, timber is generally the cheaper of the two. It appears, therefore, that timber will always be used to a considerable extent in works of construction. Timber in yielding gives more warning than iron, so that an accident can generally be foreseen and prevented. The chief objections to the use of timber in this colony is its liability to decay from dry rot, and to the attacks of the white ant. Where timber is used in marine works it is liable to the attacks of the teredo.

In the Wagga Wagga timber viaduct, which was thoroughly inspected by the Railway Bridges Inquiry Commission, it appears that, owing to the difficulty of obtaining ironbark timber for the

whole structure in the short space of time allowed for its erection, other kinds of timber were used for the piers, such as stringybark, ash, messmate, apple, box, spotted and white gum of which a large proportion had to be cut when the sap was up, instead of during the winter months. In consequence of this dry rot soon appeared in many of the piles, and this decay, together with the cavity or pipe in some of them, reduced considerably their sectional area. There is considerable uncertainty in the time which a timber viaduct may be supposed to last in this colony.

The following experiments have been made in order to compare the relative merits of two forms of timber viaducts as used in New South Wales and Victoria. In New South Wales for spans of 29 ft. 6 in. and 26 ft. respectively, four compound beams are used on piers formed with round piles which are diagonally braced, *see* plate 12. In Victoria and in Tasmania for spans of 30 ft. a strutted timber beam is used on timber trestle piers, *see* plate 14. Two model compound beams were constructed exactly one-eighth the size of those used in the actual viaduct, *see* fig. 7. Two model strutted beams were also constructed of the same timber, *see* fig. 10. It will be observed that this latter is adapted to the same span as the compound beam, the model is not made in the same manner as the strutted beam used in the Victoria viaducts, on account of the difficulty in making small scale castings, the strength however cannot be much affected by the alteration.

The quantities of timber used in model compound beam are as follows :—

2 beams	44¼ in.	×	1½ in.	×	1½ in.	= 199 cubic inches
8 half transomes	10 ,,	×	1½ ,,	×	0¾ ,,	= 45 ,,
4 half corbels ...	7½ ,,	×	1½ ,,	×	1½ ,,	= 34 ,,
					Total quantity of timber	= 278 ,,

The quantities used in strutted beam are :—

2 beams... ...	44¼ in.	×	2 in.	×	0¾ in.	= 132·75
2 struts... ...	18 ,,	×	1¼ ,,	×	1¼ ,,	= 56·25
1 straining piece	26 ,,	×	2 ,,	×	1¼ ,,	= 65·00
					Total quantity of timber	254·00

The ironwork in the models is about the same in each, although in the Victorian viaducts there is considerably more ironwork than in the New South Wales viaducts.

The models were tested horizontally in the machine, the load at end of projecting cantilevers (representing effect of weights of adjacent spans) was applied by means of a hanging weight attached to a string passing over a pulley. This weight is denoted by w, in the following tables of experiments, while the weight applied in the centre of model is denoted by W.

The following table shows the loads and deflections :—

W.	Central Deflection When $w = 0$, bolts tight.	Central Deflection $w = 28$, bolts tight.	Central Deflection $w = 50$, bolts tight.	Central Deflection When $w = 28$, bolts slack.
lb.	inches.	inches.	inches.	
100	0·09	0·04	0·04	0·05
200	0·15	0·10	0·07	0·13
300	0·20	0·15	0·15	0·21
400	0·28	0·20	0·20	0·27
500	0·35	0·29	0·28	0·34
600	0·40	0·35	0·35	0·41
700	0·47	0·40	0·40	
800	0·50	0·46	0·47	

The deflections given in the first three columns show that the compound beam as constructed in model is partially continuous.

The following table shows the effect produced with the corbels and overhanging cantilevers removed :—

W.	Central Deflection, bolts tight.	Central Deflection, bolts slack.
lb.		
100	0·06	·06
200	0·12	0·14
300	0·18	0·21
400	0·26	0·30
500	0·33	0·37
600	0·41	0·44
700	0·48	0·52
800	0·56	0·60
900	0·62	0·68
1,000	0·70	

The top beam and transomes were removed, *see* fig. 8 and the experiments made as indicated in following table :—

W.	Central Deflection $w = 0$.	Central Deflection $w = 14$.	Central Deflection $w = 28$.
lb.	inches.	inches.	inches.
50	0·10	0·06	0·06
100	0·18	0·16	0·14
150	0·26	0·24	0·20
200	0·42	0·32	0·28
250	0·44	0·40	0·36
300	0.50	0·46	0·44
350	0·58	0·56	0·54
400	0·66	0·64	0·62

The compound beam is thus seen to be about 3·5 times as stiff as one of the two single beams of which it is composed.

The following table shows the deflections and loads producing them, when the two beams were bolted together without transomes (see fig. 9):—

W.	Central Deflection w = 0 or 28, bolts tight.	Central Deflection w = 28, slack bolts.
lb.		
100	0·04	0·07
200	0·10	0·16
300	0·16	0·24
400	0·23	0·30
500	0·28	0·38
600	0·34	0·44
700	0·41	0·50
800	0·46	0·56
900	0·52	0·62
1,000	0·59	0·66

After making the experiments which have already been described, the compound beam was again built up and tested, to the breaking point, a weight of 14 lb., was suspended from each of the cantilevers in the manner before described, which was allowed to remain throughout the experiment. As the deflection of the beam increased the ends *a a*, fig. 7, were driven tightly against each other, and the ends *b b* were drawn apart, this had the effect of bending the bolts passing through the corbels. The beam gradually broke down with 2,100 lb. applied in the centre.

The deflections and loads producing them are given in the following table:—

W.	Central Deflection.	W.	Central Deflection.	W.	Central Deflection.
lb.	inches.	lb.	inches.	lb.	inches.
100	0·06	800	0·46	1,500	0·92
200	0·12	900	0·52	1,600	1·00
300	0·16	1,000	0·59	1,700	1·07
400	0·22	1,100	0·66	1,800	1·17
500	0·26	1,200	0·72	1,900	1·26
600	0·32	1,300	0·78	2,000	1·34
700	0·39	1,400	0·86	2,100	.....

Another compound beam was then built and tested, with two concentrated weights each 5 ft. from the centre of beam, so that the distance between two weights was 10 ft. The beam broke down with a total load of 3,200 lb., or 1,600 lb. at each point. The equivalent distributed and central loads is found in the

following manner :—The maximum moment of flexure due to the two concentrated weights is $1600 \times 17{\cdot}125 = 27{,}398{\cdot}4$.

$$\therefore \frac{W\,l}{8} = \frac{W \times 44{\cdot}25}{8} = 27{,}398{\cdot}4.$$

$\therefore W = 4{,}954$ the equivalent distributed load, or $2{,}477$ = the equivalent central load. The mean central breaking load may therefore be taken as $\frac{2{,}477 \times 2{,}100}{2} = 2{,}288$ lbs.

And the breaking central load for the full sized beam 29 ft. 6 in. span will be $64 \times 2{,}288 = 70$ tons nearly, which agrees with the result given in the report of the Railway Bridges Inquiry Commission.

The loads and deflections produced are shown in the following table :—

W.	Central Deflection.	W.	Central Deflection.	W.	Central Deflection.	W.	Central Deflection.
lb.	inches.	lb.	inches.	lb.	inches.	lb.	inches.
100	0·05	900	0·39	1,700	0·79	2,500	1·38
200	0·08	1,000	0·43	1,800	0·84	2,600	1·50
300	0·10	1,100	0·50	1,900	0·89	2,700	1·59
400	0·13	1,200	0·53	2,000	0·97	2,800	1.87
500	0·17	1,300	0·59	2,100	1·04	2,900	1·97
600	0·25	1,400	0·63	2,200	1·09	3,000	2·05
700	0·30	1,500	0·71	2,300	1·18	3,100	2·29
800	0·35	1,600	0·76	2,400	1·25	3,200	.....

The compound beam is therefore, at least, three times as strong as one of the simple beams of which it is composed.

By observing the behaviour of the beam while the above tests were in progress, or even by inspecting the fractured model, it is seen that the beam is deficient in horizontal shearing resistance. It can be proved that the distribution of shearing stress on any section of a solid rectangular beam is represented graphically by means of a parabola, whose central ordinate represents the maximum shearing stress, which occurs at the neutral axis; the shearing stress vanishes at the extreme fibres. The area of the parabola represents the total shearing stress on any section per unit of breadth, so that if F = the total shearing stress at any section; and x = the central ordinate of parabola; h = depth of beam, and b = breadth of beam.

$$\therefore F = \frac{2}{3}\, x\, h\, v$$

$$\therefore x = \frac{3\,F}{2\,b\,h}$$

x therefore equals the intensity of longitudinal shearing stress at the neutral axis of the beam. If we take the case of two beams bolted together without transomes, this longitudinal shear will have to be resisted by the bolts, otherwise the two beams will not act as a solid beam of the same depth; there will also be considerable bending stress on the bolts. If wedges were driven into slots cut half into each beam at the junction (which may be considered the neutral layer), the sectional area of the wedges being determined with reference to the longitudinal shearing stress x, and the resistance of the material of the wedges to shearing stress, the author considers that the two beams would then act more nearly as a solid beam of the same depth. To get the maximum strength out of two beams with transomes between them, the transomes should be notched into the upper and lower beam. The depth of the notching can easily be found by drawing the parabola of shearing stress as for a solid beam of the same depth as the compound beam and drawing ordinates at the same distance from the neutral axis as the notchings. In this way the longitudinal stress is determined, and it is then only necessary to know the resistance of the material to shearing stress, both along and across the grain.

The following experiments were made on a strutted beam, *see* fig. 10, the load was applied in the centre, and a weight of 50 lb. was connected with the extremity of the cantilevers to represent the effect of the weight of adjacent spans, in the manner already described three sets of experiments were made; first, with a central weight, which was increased to the breaking point which occurred with 2,850 lb. The beam failed immediately over the points *a a*.

The following tables show loads and deflections:—

W.	Central Deflection.	W.	Central Deflection.
lb.	inches.	lb.	inches.
100	0·05	1,300	0·47
200	0·10	1,500	0·52
300	0·12	1,700	0·59
500	0·17	1,900	0·67
700	0·24	2,100	0·75
900	0·32	2,300	0·82
1,100	0·41	2,500	0·87
		2,800	

The broken timber was then replaced with sound timber, and the load applied at the points *a a*, in order to test the struts, the

experiment was only continued up to a load of 1,000 lb. on each strut. The loads and deflections are given in following table :—

W.	Central Deflection.	W.	Central Deflection.
lb.		lb.	
100	0·00	1,500	0·16
500	0·05	2,000	0·20
1,000	0·11		

The load was then applied at points situated 10 in. apart, each 5 in. on either side of the centre, the beam broke in the same place as before, immediately over points *a a*, with a total load of 4,800 lbs., or 2,400 lbs. at each of the two points of application.

The loads and deflections are given in the following table : —

W.	Central Deflection.	W.	Central Deflection.
lb.	inches.	lb.	inches.
100	0·05	2,000	0·26
200	0·06	2,400	0·28
400	0·08	2,800	0·30
600	0·11	3,200	0·32
800	0·15	3,600	0·34
1,000	0·20	4,000	0·38
1,200	0·22	4,400	0·41
1,400	0·23	4,800	
1,600	0·24		
1,800	0·25		

In the course of the experiment it was observed that as the deflection of the beam increased the piers moved horizontally and the packing pieces at *b b* had to be removed and replaced by others prepared to prevent the beam sliding horizontally on the piers. The feet of the piers had also to be prepared to prevent them sliding horizontally. In the actual viaduct there must be considerable bending stress on the piers, due to unequal loading.

It will be observed by comparing the foregoing experiments that the strutted beam is slightly stronger than the compound beam for a central load, but that it is 50 per cent. stronger than the componnd beam for the two concentrated loads.

The author proposes in a future paper to give the results of experiments on built compound beams, in which wedges or notched transomes are used to resist the horizontal shearing stress, also the longitudinal and transverse resistances of the wedges or transomes according to the timber used.

In conclusion, the author desires to thank Mr. C. Goodchap, the Commissioner for Railways, and Mr. Cowdery, Engineer-in-Chief

for Existing Lines, for their kindness in allowing him to have the remains of the large beam tested by the Railway Bridges Inquiry Commission, and for sending to the University the specimens cut for testing.

Discussion.

Mr. J. A. M'Donald, A.M.I.C.E., said:—Hearing that Professor Warren in his paper on the strength of Colonial timbers intended touching on the question of compound beams, he thought it might be of interest to many members of this Society if he introduced a practical and to some extent graphical method of calculating the strength of these beams.

The beam shown on plate 15 is 29 ft. centres of bearings, and is composed of three logs, each 12 in. × 12 in. bolted and keyed together as shown. The main object of this diagram is to show that if a compound beam be correctly designed to take the shearing stresses, the strength of the compound beam is equal to that of a solid beam of the same total section.

The breaking strength of a solid beam 3 feet deep, 12 inches wide, and 29 feet centres, would be 170 tons with a centre load, or 340 tons with a distributed load, taking the modulus of rupture of ironbark at 12,768 lbs.

The total breaking strength of three beams each 12 inches × 12 inches and 29 feet centres, laid on top of one another without bolts or keys, would be 57 tons with a centre load, or 114 tons with a distributed load, or one-third the strength of the solid beam. It will be seen, therefore, that the strength of the compound beam can vary between one and three depending entirely on the provision made to take the horizontal shear.

The amount of horizontal shearing stress on the keys is obtained in the following manner:—Draw diagrams of mean vertical shearing stresses for both dead and live loads, as shown by curves *A B C* and *D E F*; the sum of these two is, of course, the total mean vertical shear which we will call *S*. Then $\frac{3}{2} \times S$ = maximum horizontal shear at the neutral axis of the beam. Lay off $G\,H = \frac{3}{2}\,S$, and construct a parabola with height = *G H* and base = total depth of beam. The horizontal shearing stress at any point on the vertical section is then given by scaling the length of the ordinate at that point, as *K L* for the compound beam shown. On plate 15 these parabolas have been plotted for each key, and the horizontal shear taken at 6 inches from the neutral axis. The crushing strength of the keys has been taken at 4 tons on the square inch, and the factor of safety at 6·6, which gives a safe strain of 0·6 tons per square inch, the keys being proportioned accordingly. The bolts have been arranged at 3 feet pitch, and the stress on them has been obtained from the diagram of vertical shear, the safe stress being taken at 4·5 tons per square inch.

By the above arrangement of keys and bolts it will be seen

that the maximum shearing stresses are fully provided for, and it only remains now to show that the beam is not weakened by cutting holes for the keys. The curve *M Q* represents to scale the bending moments on the beam, due to an evenly distributed load of 340 tons; the curve *M P* represents the moments of resistance, which have been calculated for the reduced section of the beam at each key; and the line *M O* represents the moments of resistance of a similar beam if solid. It will be clearly seen that the curve of moments of resistance falls well outside the curve of bending moments, showing that the section left after cutting the key holes is ample for the stress that comes upon it, and that the beam as compounded of three separate beams is equal in strength to a solid beam of equal scantling.

Were it not so late, he would have liked to make a few remarks on the paper before the meeting, but he must content himself by thanking Professor Warren for his most valuable and interesting paper, containing as it does data, which every engineer in this colony has felt the need of and been unable to obtain with accuracy. The tests have evidently been most carefully made, and the results are proportionately valuable. The members will look forward with interest to the further paper on this subject which Professor Warren has promised them.

Mr. Chas. Moore said that the remarks of Professor Warren opened out an interesting discussion, inasmuch as our timbers are only valuable in accordance with the way in which they are obtained. Timber in this country is cut all the year round, which is a great mistake. If an oak tree be cut down when in full sap the chances are that in twelve months time fungus or dry-rot will be found to exist in it. The timbers of the Exhibition of 1862 were selected by Sir William Macarthur and himself. They took care that the wood was collected only at the proper time. Some of this timber could now be seen in the Kew Museum. Some sleepers will last for a few years, others for a longer or shorter time, and this is due in a general way almost entirely to the time of year when the tree is felled. Col. Ward in his experiments on ironbark stated that he had tried five kinds, and had found the white ironbark of Illawarra to be the strongest.

Mr. Trevor Jones, C.E., said that engineering in this colony has been suffering from the want of experiments, there being no lack of theories. The experiments of Professor Warren were useful as affecting the timbers we are using every day. In erecting bridges in the colony for some nine years he had allowed for a stress of 17,000 lb. per square inch; this estimate was too high according to Professor Warren, who had reduced it to 13,000. He was sure that all the engineers in the colony would desire the paper to appear in a published form in its entirety.

[Six diagrams.]

IRON BARK

Plate 1.

Fig 1

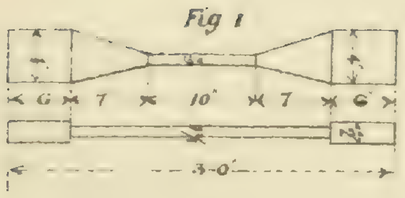

Fig 2

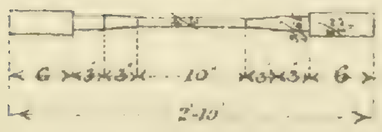

Fig 3

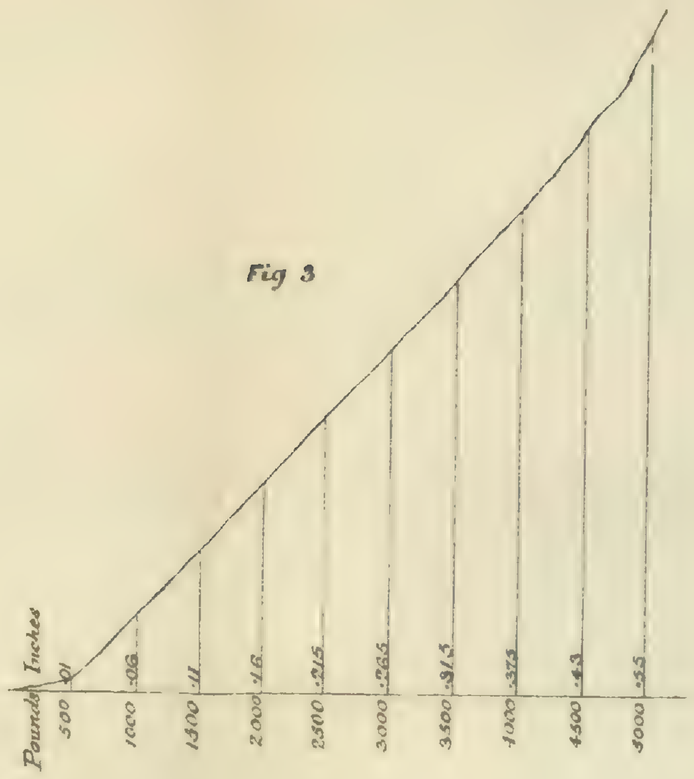

Fig 4

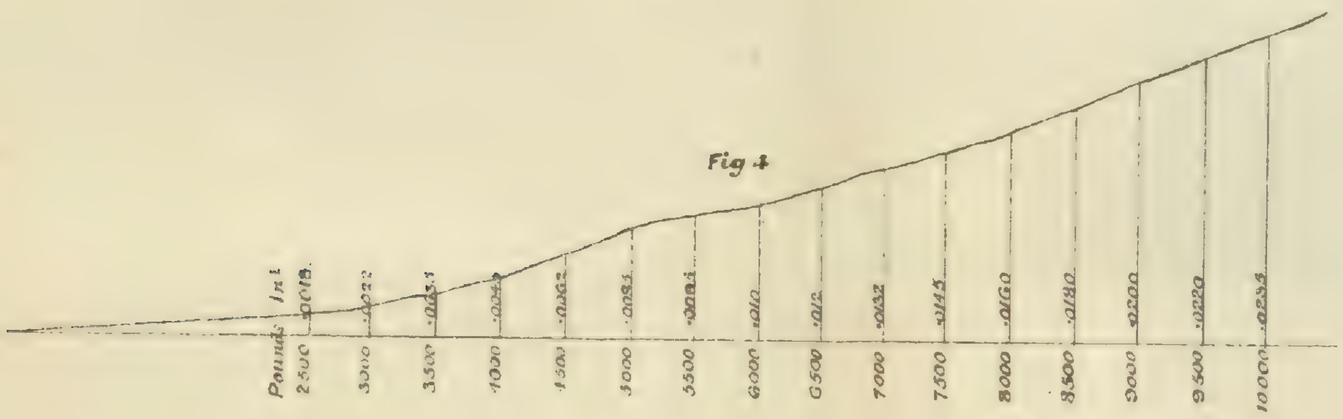

Fig 5

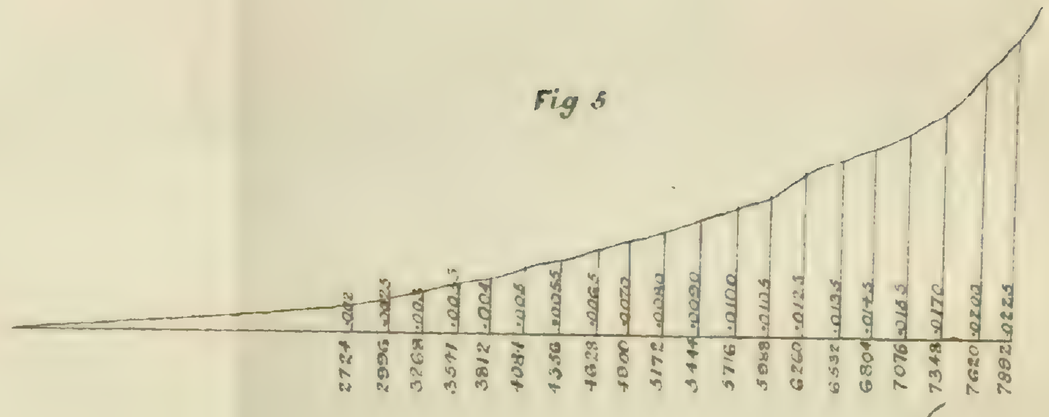

Fig 6

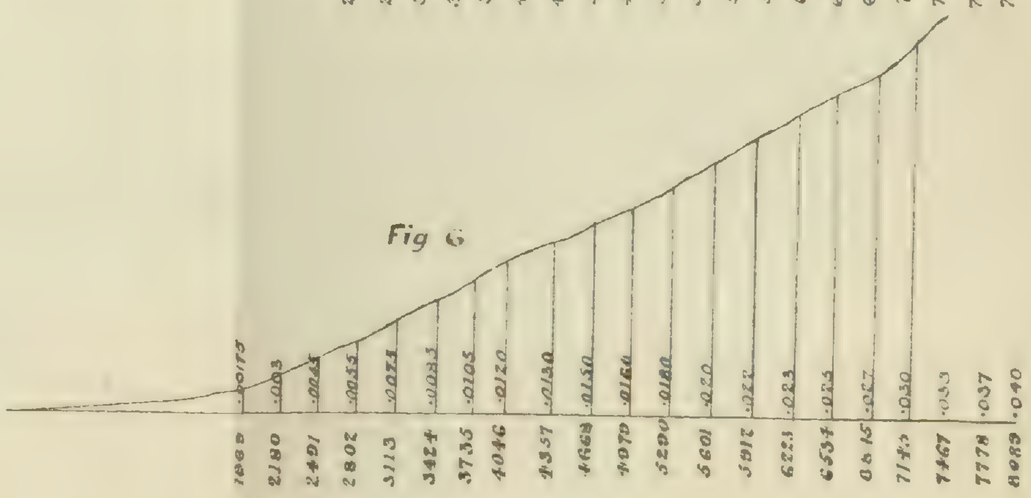

Fig 7

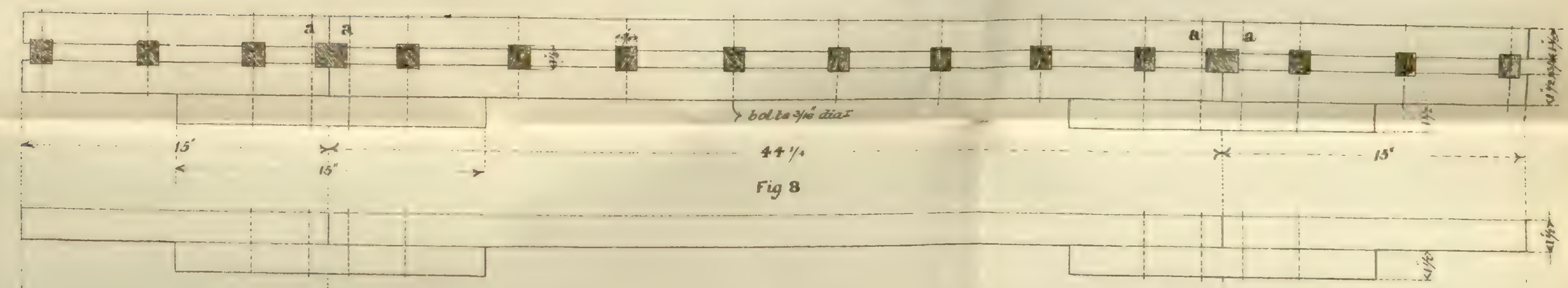

Fig 8

Fig 9

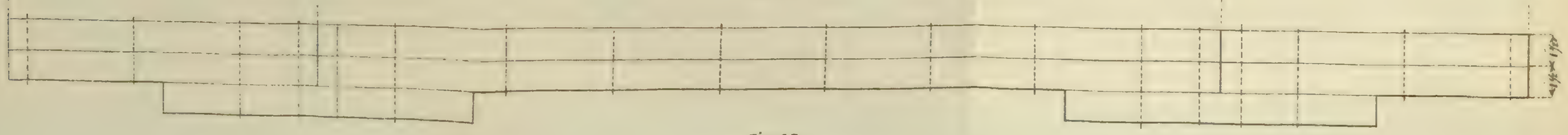

Fig 10

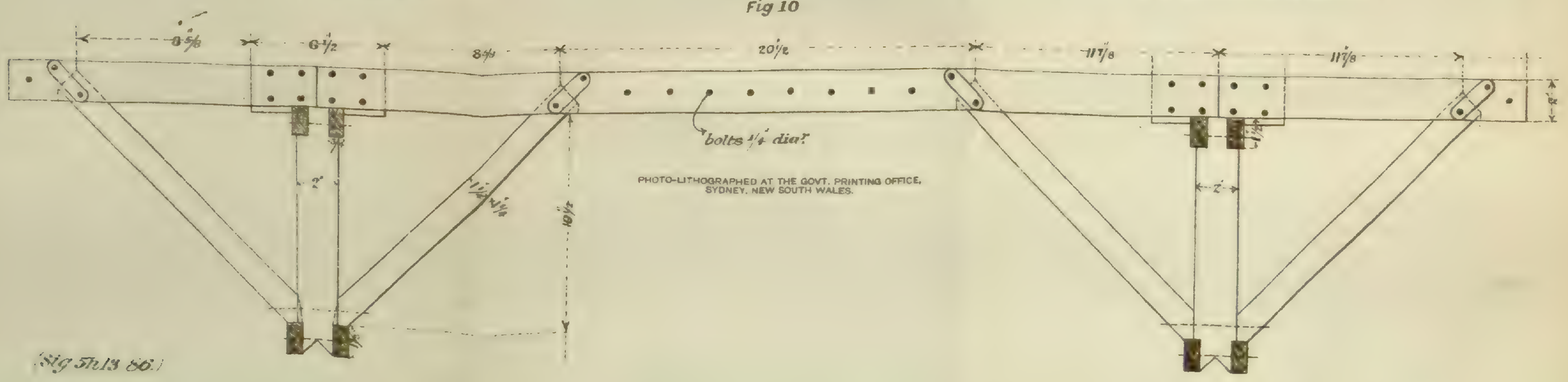

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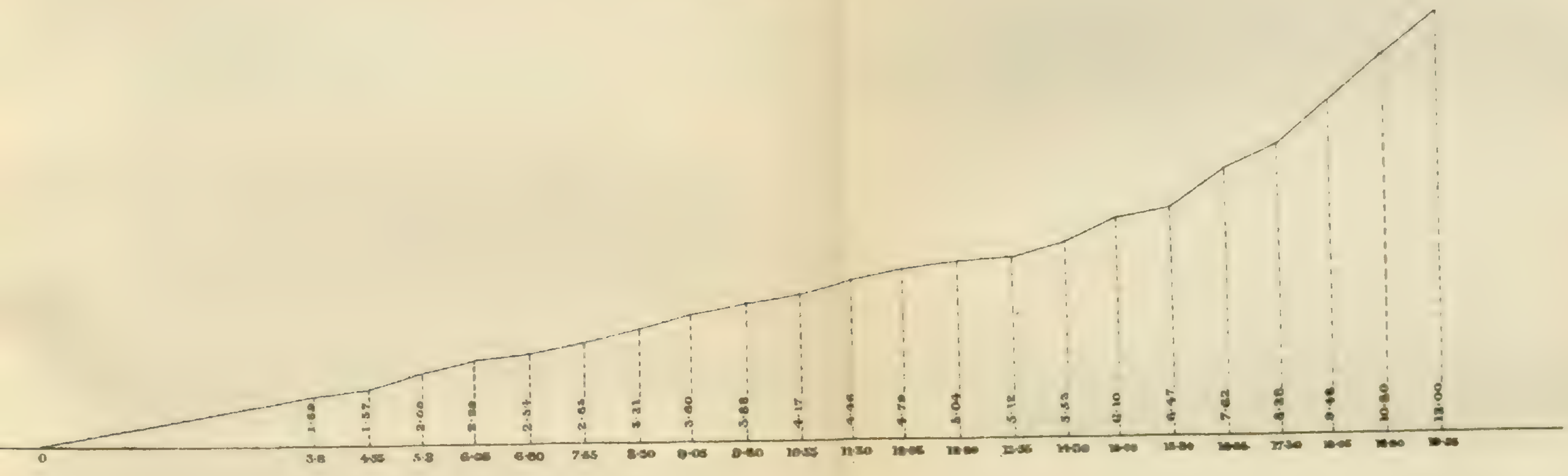
Diagram of Breaking Experiment

Fig. II.

Ironbark beam 12¾ × 12¾, Span 28·6 clear or 25·6 centres, loaded in centre

Horizontal Scale — 2 Tons to One Inch
Vertical " — 3 Inches to One Foot



NOTE.—The beam cracked with 16·55 tons, but did not break until 19·55 tons had been suspended from the centre.

(Sig 5413-06)

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Plate 12.

WAGGA WAGGA VIADUCT

From Drawing supplied by the Engineer for Existing Lines.

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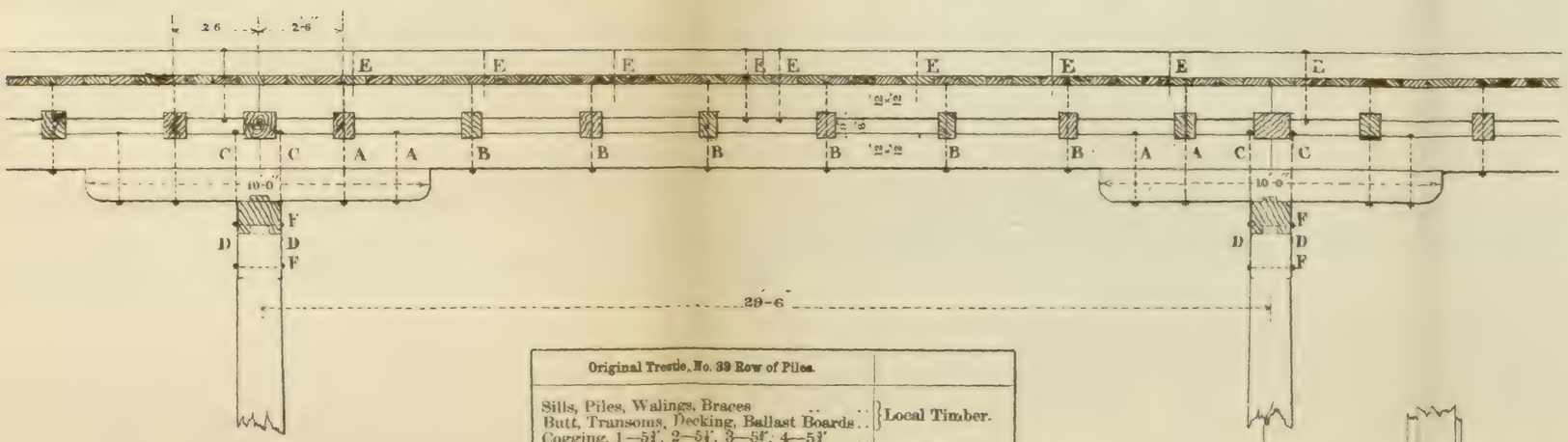
LONGITUDINAL SECTION OF ONE 29-6 SPAN



Original Trestle, No. 39 Row of Piles.	
Sills, Piles, Walings, Braces	Local Timber.
Butt, Transoms, Decking, Ballast Boards ..	
Cogging, 1—5½', 2—5½', 3—5', 4—5½' ..	
Headstocks, Corbels, Girders	Ironbark.

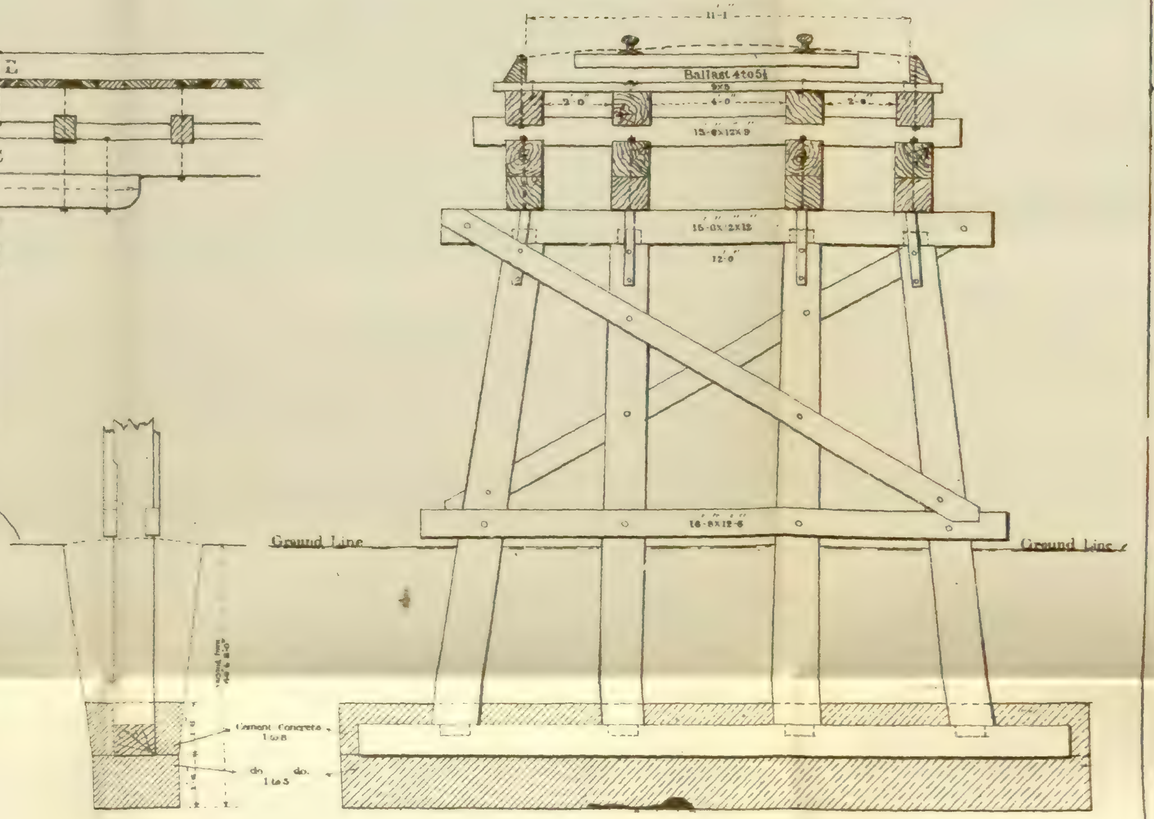
Iron in One Span.

Bolts, &c.		Diam.	No.	Length.	Weight. cwt.	qr.	lb.	oz.
Straps	A	1¼'	8	3' 6"	2	0	25	8
	B	1'	24	2' 6"	1	2	12	0
	C	1"	8	2' 4"	1	0	25	0
	D	3" × ½	3	2' 3"				
	E	¾'	4 × 6	spikes	0	0	20	2
	F	¾'	16	13"	0	2	4	0
Spikes	—	6" × ¼'	160	—	0	1	12	0
Total					6	0	14	10

Timber in One Span.

Piles, Braces, Butt Pieces, Transoms, Deck Plating, Ballast Boards.	Local Timber.
Headstocks, Corbels, Girders	Ironbark.
Butt Pieces, 12' × 3', Transoms, 9' × 6', Decking, 9' × 3'.	—
Ballast Boards, 6" × 9" × 3"	
Average weight of Ironwork in each Bay ..	cwt. 6 qr. 0 lb. 14 oz. 10

Original Trestle N° 39 Row of Piles



NOTE.—Level of top surface of concrete at every fifth trestle is at ground line.

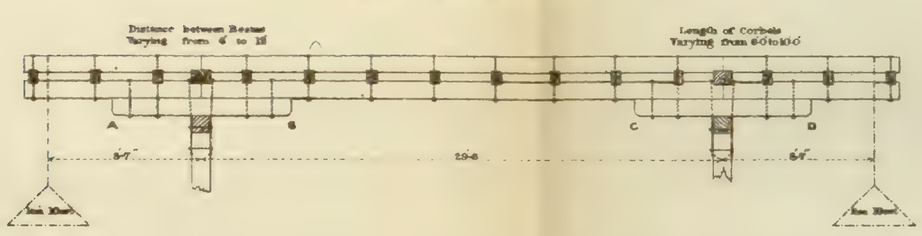
Level of top surface of concrete at the four intermediate trestles is at the upper surface of the bottom timber bracing.

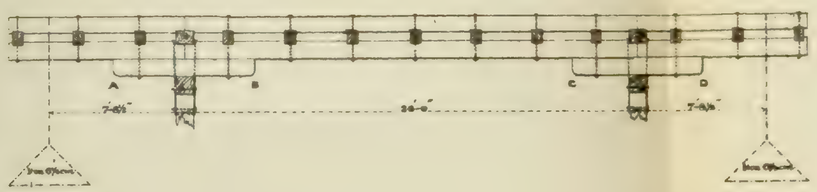
(Sig 5h 13-86.)

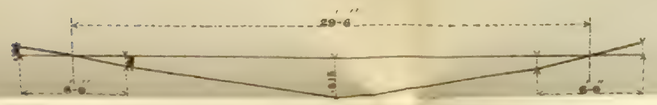
Diagram of Experiments made at the Government Yard, Clyde, for testing the strength of Timber Girders.

SCALE OF FEET

Compound Girder
Similar to those of Wagga Viaducts







Test of Compound Beam, 29′ 6″ long.

(With 10ft. Corbels.)

No. of Exp.	Load in Tons.	Distance between Beams.	Deflection at Centre.
			Inches
3-5	8·67	12″	·84
6-9	8·67	9″	·713
17-19	9·61	9″	·804
10-11	9·98	9″	·828
18-16	8·67	6″	·716
20-23	8·30	6″	·692
32-34			
24-29			

(Distance between Beams, 6′.)

No. of Exp.	Load in Tons.	Length of Corbel.	Deflection at Centre.	Deflection of Corbels. A	B	C	D
			Inches	Inches	Inches	Inches	Inches
32-34	8·67	10′ 0″	·716	·235	·330	·348	·228
45-47	8·67	8′ 0″	·746	·231	·300	·312	·228
42-44	8·30	8′ 0″	·720	·204	·276	·300	·204
39-41	7·92	8′ 0″	·680	·174	·252	·288	·204
48-51	8·67	6′ 0″	·815	·192	·261	·216	·108
51-54	8·10	6′ 0″	·787	·174	·235	·204	·102
55-57	7·5	6′ 0″	·759	·159	·216	·186	·184

Test of Compound Beam, 26′ 0″ long.

No. of Exp.	Load in Tons.	Length of Corbel.	Deflection at Centre.	Deflection of Corbels. A	B	C	D	Remarks.
			Inches	Inches	Inches	Inches	Inches	
78-80	8·67	8′ 0″	·597	·172	·308	·174	·198	
81-83	10·55	,, ,,	·756	·260	·366	·368	·294	
84-86	9·62	,, ,,	·657	·228	·329	·324	·228	
87-89	9·98	,, ,,	·679	·204	·384	·296	·210	
90-93	8·30	,, ,,	·539	·180	·264	·270	·204	
94-96	8·30	,, ,,	·797	·276	·357	·392	·294	Slack Bolts.
97-99	7·36	,, ,,	·732	·252	·344	·360	·282	,, ,,
100-102	6·42	,, ,,	·762	·228	·296	·196	·240	,, ,,
103-105	8·42	,, ,,	·329	·108	·166	·210	·156	No Transoms.
106-108	7·36	,, ,,	·402	·132	·256	·180	·204	,, ,,
109-111	8·30	,, ,,	·484	·148	·232	·294	·228	,, ,,
112-114	9·23	,, ,,	·578	·186	·260	·210	·270	,, ,,
115-117	9·23	,, ,,	·830	·288	·372	·512	·427	Slack Bolts.

(Sig. 5h 13-86.)

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Plate 14.

VICTORIAN RAILWAYS

GIPPSLAND RAILWAY

DETAILS OF THE 30 FT OPENINGS OF THE BRIDGES OVER THE THOMSON AND LATROBE RIVERS

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(Sig 5h 13-86)

COMPOUND BEAM

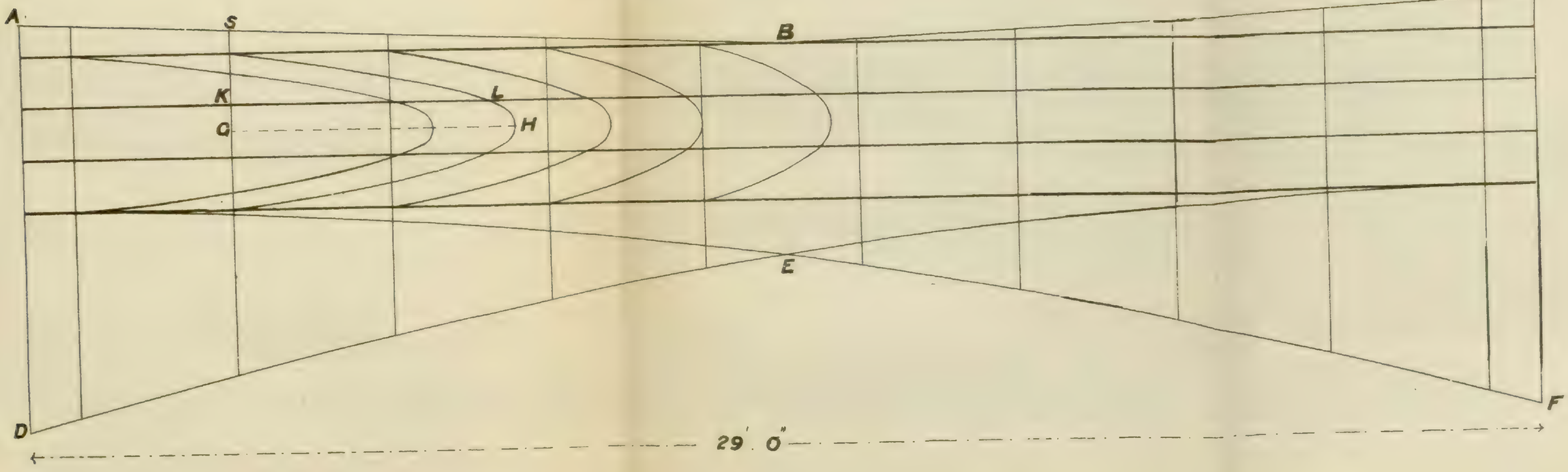
Plate 15.

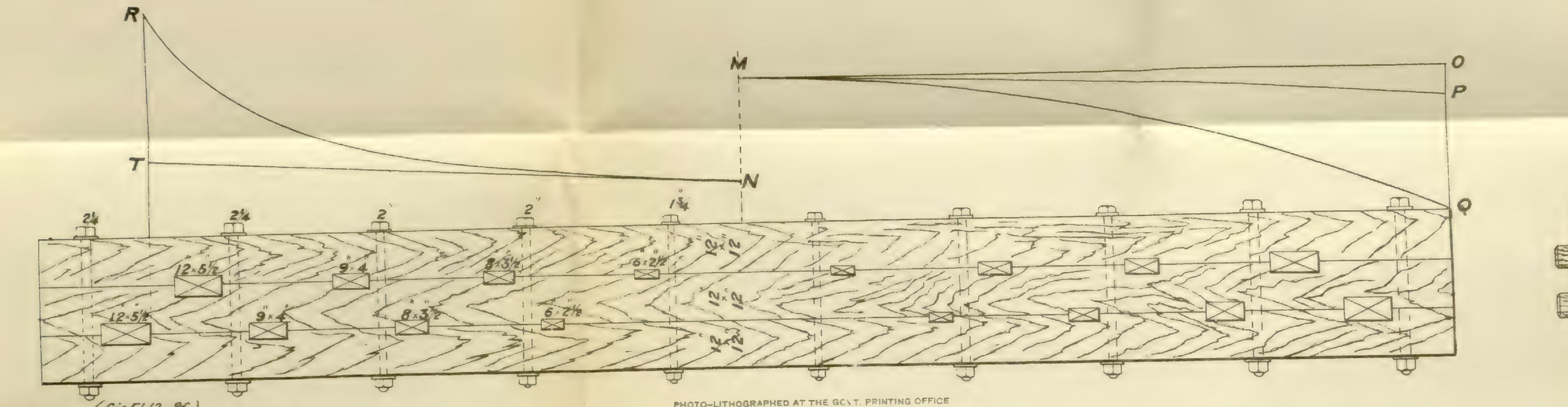
Scale of timber work

do " moments

" " shear

" " curves BN*TN





(Sig 5h13-86.)

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SYDNEY, NEW SOUTH WALES.

PROCEEDINGS.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF NEW SOUTH WALES.

WEDNESDAY, 5 MAY, 1886.

ANNUAL GENERAL MEETING.

Professor LIVERSIDGE, F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following Financial Statement for the eleven months ending 31st March, 1886, was presented by the Honorary Treasurer :—

GENERAL ACCOUNT.

	RECEIPTS.	£	s.	d.	£	s.	d.
To subscriptions	One Guinea	300	6	0			
	Two Guineas	289	16	0	622	13	0
	Arrears	32	11	0			
,, Parliamentary Grant on subscriptions received in 1885 ...		318	3	0			
,, freight and charges repaid		2	5	0			
,, commission on cheques remitted		0	8	0			
Total receipts		£943	9	0			
,, balance in Bank on 1st May, 1885		17	2	1			
		£960	11	1			

Expenditure.

	£	s.	d.
By advertisements	19	6	0
,, Assistant Secretary, salary 11 months	183	6	8
,, ,, ,, gratuity	16	13	4
,, books and periodicals	310	11	11
,, engraving and lithographing illustrations for Journal ...	18	13	6
,, freight and charges, packing, &c.	34	15	11
,, furniture and effects	16	15	6
,, gas account	17	18	1
,, housekeeper, to 31st March	10	0	0
,, interest on mortgage	54	0	0
,, insurance on premises	5	0	0
,, insurance on books and furniture	3	14	0
,, medals for awards	50	2	0
,, postage and duty stamps	41	5	0
,, petty cash expenses	15	15	0
,, printing	21	4	0
,, rates—city, water, and sewer	27	12	6
,, refreshments and attendance at General Meetings... ...	10	18	0
,, repairs and painting	37	8	10
,, stationery	9	5	3
,, sundries, including law charges	12	13	11
Total expenditure	£916	19	5
,, balance in Bank on 31st March, 1886	43	11	6
	£960	11	1

ROBERT HUNT, Honorary Treasurer.
W. H. WEBB, Assistant Secretary.

Audited—
W. C. W. Bartels,
P. N. Trebeck.
Sydney, 22nd April, 1886.

BUILDING FUND ACCOUNT.

Receipts.

	£	s.	d.
To entrance fees	50	8	0
,, subscriptions	35	10	0
,, Parliamentary Grant	32	19	0
,, rent of hall	62	1	0
Total receipts	£180	18	0
,, balance in Bank on 1st May, 1885	19	19	5
	£200	17	5

Expenditure.

	£	s.	d.
By alterations and additions to building...	131	5	0
,, balance in Bank on 31st March, 1886	69	12	5
	£200	17	5

ROBERT HUNT, Honorary Treasurer.
W. H. WEBB, Assistant Secretary.

Audited—
W. C. W. Bartels,
P. N. Trebeck.
Sydney, 22nd April, 1886.

CLARKE MEMORIAL FUND.

	£	s.	d.
To amount of fund on 1st May, 1885	241	16	6
,, interest accrued to 31st March, 1886...	5	10	7
	£247	7	1

	£	s.	d.
By fixed deposit in Union Bank	156	13	4
,, balance due from Oriental Bank	90	13	9
	£247	7	1

ROBERT HUNT, Honorary Treasurer.
W. H. WEBB, Assistant Secretary.

Audited—
W. C. W. BARTELS,
P. N. TREBECK.
Sydney, 22nd April, 1886.

PROFESSOR SMITH MEMORIAL FUND.

	£	s.	d.
To eighty-five subscriptions (limited to £1 1s.)	88	9	6
	£	s.	d.
By deposit at call at Union Bank...	88	9	6

ROBERT HUNT, Honorary Treasurer.
W. H. WEBB, Assistant Secretary.

Audited—
W. C. W. BARTELS,
P. N. TREBECK.
Sydney, 22nd April, 1886.

Messrs. W. A. Dixon and S. MacDonnell were elected Scrutineers for the election of officers and members of Council.

A ballot was then taken and the following gentlemen were duly elected officers and members of Council for the current year :—

HONORARY PRESIDENT:

HIS EXCELLENCY THE RIGHT HON. LORD CARRINGTON, G.C.M.G., &c., &c., &c.

PRESIDENT:

CHRISTOPHER ROLLESTON, C.M.G.

VICE-PRESIDENTS:

H. C. RUSSELL, B.A., F.R.A.S., &c.
DR. ADOLPH LEIBIUS, M.A., F.C.S.

HONORARY TREASURER:

ROBERT HUNT, F.G.S., &c.

HONORARY SECRETARIES:

PROFESSOR LIVERSIDGE, F.R.S., F.C.S., F.G.S., &c.
F. B. KYNGDON, F.R.M.S., *Lond.*

COUNCIL:

HON. C. K. MACKELLAR, M.L.C., A.M., M.B.
CHARLES MOORE, F.L.S.
P. R. PEDLEY.
J. ASHBURTON THOMPSON, M.D., *Brux.*
C. S. WILKINSON, F.G.S., F.L.S.
H. G. A. WRIGHT, M.R.C.S.E., &c.

The following gentlemen were duly elected ordinary members of the Society :—

Bowman, Arthur, Sydney.
Dunn, Edward Casey, Ashfield.
Rigg, Thomas S. J., B.A., Sydney.

The certificates of two new candidates were read for the second time, and of seven for the first time.

The names of the Committeemen of the different Sections of the Society were announced, viz. :—

Microscopical Section.—Chairman : P. R. Pedley. Secretary : F. B. Kyngdon. Committee : Dr. Morris, H. G. A. Wright, M.R.C.S.E., T. Whitelegge, and T. F. Wiesener.

Medical Section.—Chairman : Sir Alfred Roberts. Secretaries: Dr. Ashburton Thompson, Dr. A. McCormick. Committee : Hon. Dr. Mackellar, M.L.C., Dr. Thomas Evans, Dr. Knaggs, Dr. Chambers, Prof. Anderson Stuart, M.D., Dr. F. N. Manning.

Five hundred and ninety-four donations of books, periodicals, &c., and seven charts, were laid upon the table, and duly acknowledged.

A circular was read from the secretary of the Elizabeth Thompson Science Fund, Boston, U.S. America, inviting applications for grants of money in aid of scientific work. The circular was afterwards affixed to the notice board in the hall.

The Chairman announced that the Council intended to hold a conversazione during the present year.

Professor Liversidge, F.R.S., President, then read his address.

Dr. Leibius said he took this opportunity of thanking their retiring president for the kind manner in which he had referred to his (Dr. Leibius') past services as one of the hon. secretaries during the last eleven years. He had always had great pleasure in doing whatever he could to forward the interests of the Society, and he felt gratified that Professor Liversidge had consented to resume the duties of an honorary secretary once more. He regretted that living away from town compelled him to resign the position of honorary secretary, and in the new office as one of the two vice-presidents, to which they had just done him the honour to elect him, he would endeavour to uphold the dignity of the position.

Sir Alfred Roberts, in rising to propose a vote of thanks to the late president, said :—"Before the past president leaves the chair I think we ought to offer him a very cordial vote of thanks for the very able and lucid address which he has just delivered, and from which we have derived so much pleasure. It has evidently been the result of a great deal of very earnest thought on his part."

Professor Liversidge, in rising to acknowledge the compliment just tendered him, said that as he had occupied so much of their time already he would not detain them with a long reply. He expressed his sense of the gratifying terms in which the vote of thanks had been proposed, and especially for the impressive way in which it had been passed by the meeting. As one of the honorary secretaries he would be happy to continue to do his best to promote the interests of the Society.

Mr. C. Rolleston, on taking the presidential chair, said – I must confess I would have felt better pleased if the choice of the Society had fallen upon some one better able than I am to discharge the duties of the high position to which you have elected me to-night. I will endeavour, to the best of my ability, to do what is necessary for the welfare of the Society while in that position, and I trust that the Society may continue to progress as it has done hitherto.

The meeting was then adjourned till the first Wednesday in June.

About forty members were present.

WEDNESDAY, 2 JUNE, 1886.

C. Rolleston, C.M.G., President, in the Chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were duly elected ordinary members of the Society :—

David, T. W. Edgeworth, B.A., F.G.S.

Quaife, William Francis, B.A., M.B., Ch.M.

The certificates of seven new candidates were read for the second time, and of four for the first time.

One hundred and thirteen donations of books, periodicals, &c., were laid upon the table.

Mr. Charles Moore, F.L.S., in the absence of the author, read a paper by Baron Ferdinand von Mueller, K.C.M.G., F.R.S., &c. "On an unrecorded Ardisia from New Guinea."

He explained that the specimen was brought from New Guinea in H.M.S. "Nelson," and forwarded with other plants to Baron von Mueller for classification. The paper was a report on the same by Baron von Mueller, who, in forwarding this description, had begged that it might be brought before the Royal Society, and published with its proceedings. One species of the Ardisia was found in Madagascar and the Moluccа Islands, another in New South Wales and Queensland, while a third (the specimen under notice) grew in New Guinea. This last was a solitary instance of the plant being found so far north. He believed that at one time the continent of Australia and New Guinea were united. It was not at all likely that gum seeds would be carried

by currents. Other proofs of the unity of the two places might be found in the statement that marsupials, red cedar, and eucalypts are the same in both, although our wood is better, probably because it grows in a southern part, as it was a fact that the farther northwards we proceed the deeper the timber becomes. Sir Joseph Hooper is of opinion that the cedar used for making cigar boxes is identical with our own cedar.

A paper by the Rev. GEORGE PRATT on "A comparison of the dialects of E. and W. Polynesian, Malay, Malagasy, and Australian," was communicated by the Rev. W. Wyatt Gill, B.A. (Lond.)

Mr. Gill, after speaking of the high respect with which the Rev. George Pratt was regarded as an authority on matters connected with the Samoan and other languages said that he wished more study were given to Polynesian dialects by those who had a taste for philology, so that now, while practicable, they might gather up the spoken and unwritten languages of these countries. It was necessary that something be done at once. The study is both interesting and important, the dialects of Polynesia being almost infinite in variety, while at the same time it is extremely difficult to trace the original words in some dialects. For example, when the natives hear a new word from Europeans .or natives of other islands, it spreads like wildfire through the villages, and children of the succeeding generation, finding such words incorporated with their elders' speech, believe them to be part of the original dialect of the island. Again, many of the islands are passing away, while within his own knowledge the language of Tahiti had changed considerably during the last few years, and many new words were being adopted. He would suggest that a polyglott of the Polynesian languages be prepared, and that the work be commenced by the Royal Society. Mr. Gill also stated that Mr. Alfred Wallace was of opinion that formerly the islands were peopled by one race, and that some idea of the migrations of the natives would be obtained, if the suggestion as to the polyglott be carried out.

Mr. Charles Moore stated that a few years ago he had taken a great deal of interest in obtaining the native names of plants in the Clarence and Richmond River district. He found that the names varied considerably in the districts, and that names were given for even the minutest plants. The names of identical trees on the Richmond and Clarence were totally different, although he had been informed that the languages were somewhat similar. He regretted that the languages of these colonies would be lost, as the natives of the coast are fast vanishing. The race of Tasmanian aborigines was now extinct, and he believed that their language had never been written.

Hon. Dr. Creed, M.L.C., alluded to the efforts made by the Rev. W. Ridley, some years ago, in recording many words of the

languages of New South Wales. It was true that nearly all the coast tribes were extinct, except on the Clarence and a few other places, but away west of the Darling and west of Queensland there were large numbers of natives yet existing who still speak the dialects in all their purity. Amongst these natives a number of white men were living who would of course possess a reliable stock of native words and native customs. The officials connected with the telegraphs of the interior were, many of them, intelligent men, who could render valuable assistance in the work, as they had often a considerable amount of leisure, and thus a beginning would be made towards a polyglott. If we allowed the languages of our aborigines to die out, we will be removing one of the sources of comparative philology.

Rev. J. P. Sunderland spoke of Mr. Pratt's enthusiasm in the study of the Polynesian dialects, and stated that many Samoan words were found amongst the Malagese. He was able to corroborate the remark made by Mr. Moore as to the names of plants varying even in districts only a few miles apart. An interesting fact respecting native botany was that the names of even the smallest plants and flowers appeared to be known to nearly every native. The migrations of natives were ascertained in many instances, where the languages had undergone such changes that the inhabitants were unable to converse with each other.

A paper by T. L. Bancroft, M.B., Edin., F.L.S., of Brisbane—"Preliminary notes on some new Poisonous Plants discovered on the Johnstone River, North Queensland, was communicated and read by Professor T. P. Anderson Stuart, M.D., Edin.

Professor Stuart suggested that the application of Australian Flora to practical medicine should be taken up by the medical profession, and if this were done he had no doubt that the large field for study in this direction would result in a considerable addition to our therapeutical knowledge.

A metallic meteorite or siderite from the Diamantina District, Queensland, exhibited by C. S. Wilkinson, F.G.S., Government Geologist, was described by Professor Liversidge.

Professor Liversidge, F.R.S., exhibited and described a collection of New South Wales silver ores (38 specimens in all) which had been collected, and in certain cases assayed by Mr. J. McGarvie Smith, from various mines at Silverton.

A model showing the geometry of one form of serpentine progression was exhibited and described by Lawrence Hargrave, Esq.

About thirty members were present.

WEDNESDAY, 7 JULY, 1886.

H. C. Russell, B.A., F.R.A.S., Vice-President, in the Chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were duly elected ordinary members of the Society :—

Brown, David, Kallara, Darling River.
Grut, Percival de Jersey, Sydney.
Heydon, L. F., M.L.A., Sydney.
MacFarlane, Edward, Bourke.
Morgan, Dr. Edward, Mount Victoria.
Provis, John, Sydney.
Smith, Walter Alexander, A.M.I.C.E., Sydney.

The certificates of four new candidates were read for the second time, and of seven for the first time.

One hundred and seventy-two donations of books, periodicals, &c., were laid upon the table.

The Chairman announced that the Sanitary Section had been resuscitated, and that the following Committeemen had been elected :—

Sanitary Section.—Chairman : Sir Alfred Roberts. Secretary : R. E. Roth, M.R.C.S.E. Committee : Dr. Ashburton Thompson, W. A. Dixon, F.C.S., F. B. Kyngdon, Dr. Fairfax Ross, Dr. F. H. Quaife, J. B. Henson, C.E.

A paper by Baron Ferdinand von Mueller, K.C.M.G., F.R.S., &c.—"Further additions to the Census of the Genera of Plants hitherto known as Indigenous to Australia" was taken as read.

Mr. Kyngdon read a paper by Mr. H. F. Madsen—"Notes on the process of polishing and figuring 18-inch Glass Specula by hand, and experiments with Flat Surfaces."

Some remarks were made by Mr. H. A. Lenehan and the Chairman.

Forty-three diagrams and twenty-five coloured lithographic plates representing views of the Straits of Sunda, and the neighbourhood of the eruption of Krakatao, were exhibited and described by Mr. H. C. Russell, B.A., F.R.A.S.

About twenty-five members were present.

WEDNESDAY, 4 AUGUST, 1886.

C. Rolleston, C.M.G., President, in the Chair.

The minutes of the last meeting were read and confirmed.

The Chairman announced with regret the death of the late Rev. Peter MacPherson, M.A., who had been a life member of the Society for eight years, and who had contributed various papers.

The following gentlemen were duly elected ordinary members of the Society :—

Edmunds, Percy James, Sydney.
Holmes, Spencer Harrison, Allandale, Hunter River.
Quayle, Edwin, Glebe Point.
Threlfall, Richard, B.A. (Cantab.), Professor of Physics, Sydney University.

The certificates of seven new candidates were read for the second time, and of five for the first time.

The CHAIRMAN announced that the Council proposed to hold a Conversazione in the Great Hall of the University, on the 6th October next.

Sixty-one donations of books and periodicals were laid upon the table.

The following letter was read from Dr. L. G. De Koninck, of Liége, acknowledging the award of the Clarke Memorial Medal :—

Professor Liversidge, President of the
Royal Society of New South Wales.

Monsieur le Président, Liége, 1 June, 1886.

I have the honour to acknowledge the receipt of the Clarke Medal, conferred by the Society on me in recognition of my long and numerous scientific researches, especially those which have had for their object the study of the carboniferous fossils of Belgium, and the palaeozoic fossils of your interesting country.

I have been more than flattered in receiving that distinction, and at seeing my name associated with those eminent naturalists upon whom this honour has been previously conferred.

It is, moreover, a precious souvenir of one who so kindly supplied me with the whole of the valuable fossils which have assisted me in my labours.

Will you, therefore, have the goodness, Monsieur le Président, to present in my name to the Royal Society of New South Wales, my lively and sincere thanks for the honour which they have been good enough to confer upon me.

Accept the homage of my most distinguished sentiments.

Dr. L. G. DE KONINCK.

Mr. S. HERBERT COX, F.C.S., F.G.S., read a paper on "The Tin Deposits of New South Wales."

After some remarks upon the same by Professor Liversidge, the PRESIDENT, on behalf of the Society, presented Mr. Cox with the Society's medal, which had been awarded to him for his valuable paper.

On the motion of the Rev. R. Collie, F.L.S., a paper by the late Rev. PETER MACPHERSON, M.A., "On the Aboriginal names of Rivers in Australia, philologically examined," was taken as read.

A discussion upon the subject of the paper took place, in which the following gentlemen took part, viz.:—Rev. Robert Collie, Sir Alfred Roberts, Messrs. J. F. Mann, E. Du Faur, and J. Trevor Jones.

Mr. H. C. Russell exhibited a number of photographs of the River Darling taken before the rise and at its present state of flood.

About thirty members were present.

WEDNESDAY, 1 SEPTEMBER, 1886.

C. Rolleston, C.M.G., President, in the Chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were duly elected ordinary members of the Society :—

Barker, William Mandeville, Sydney.
Blacket, Arthur, Sydney.
Collingwood, David, M.D. (Lond.), F.R.C.S., Eng., Summer Hill.
MacDonald, John Alexander, M.I.M.E., A.M.I.C.E., Sydney.
Newmarch, Bernard James, L.R.C.P. (Lond.), M.R.C.S.E., Bowral.
Sager, Edmund E., Sydney.
Worrall, Ralph, M.D. (Queen's Univ., Irel.), Sydney.

The certificates of five new candidates were read a second time, and of six for the first time.

One hundred and twenty-one donations of books and periodicals were laid upon the table.

Mr. Frederick B. Gipps, C.E., read a paper on "Our Lakes and their uses."

A discussion followed in which the following gentlemen took part, viz. :—Messrs. H. C. Russell, J. F. Mann, T. Whitelegge, C. S. Wilkinson, Dr. Thomas Dixon, and the Chairman.

Dr. Leibius, M.A., F.C.S., exhibited and described some beautiful specimens of gold in calcite, from the Uralla district, the lime having been dissolved in acid, the gold was left as a network of the finest ramifying filaments.

The following letter in connection with the above was also read :—

Sir, 31 August, 1886.

The quartz was taken from a reef situated about ten miles south from Barraba and about three miles east of the main road, close to a small creek locally known as "Tea-tree Creek," in the Peel and Uralla mining district.

We have been working at this reef for nearly two years. The specimens were taken from a depth of about 45 feet. The reef is well defined and is about 16 inches thick. We have sunk to water level (80 feet), and are now taking out stone showing gold freely. A battery is in course of erection, and will be ready to crush in a week.

I am, &c.,
A. ARMSTRONG.

To Dr. Leibius, M.A., F.C.S., Royal Mint, Sydney.

Remarks upon the specimens were made by Mr. C. S. Wilkinson and Professor Liversidge.

About thirty members were present.

WEDNESDAY, 6 OCTOBER, 1886.

A Conversazione was held in the Great Hall of the University, under the management of the following committee :—Christopher Rolleston, C.M.G., President ; H. C. Russell, F.R.S., Vice-President ; Robert Hunt, F.G.S., Treasurer ; A. Liversidge, F.R.S., Hon. Secretary ; F. B. Kyngdon, Hon. Secretary ; Charles Moore, F.L.S., P. R. Pedley ; J. Ashburton Thompson, M.D. (Brux.)

The hall and approaches were decorated with palms, ferns, and rare pot plants by Mr. C. Moore, F.L.S., Director of the Botanic Gardens.

Mr. F. Morley presided at the organ.

The number of guests present was between 900 and 1,000.

The following is a list of the articles exhibited :—

Fairfax, Jas. R.—Collection of coins.

Salmon, W.—Collection of Australian diamonds.

Elkington and Co.—Copies of celebrated art treasures in electro-ware, shields, plaques, vases, &c.

Paling, W. H.—Bronzed coloured bust "Kurde Woman," by Emile Guillemin. Exhibited in the Salon of 1884, Paris.

Walker, P. B.—1. Japanese pictures. 2. Japanese work.

Philip, Dr. Alex.—National Hungarian album.

Barff, H. E., Registrar.—Books from University Library.

Sinclair, Sutherland.—1. Old books. 2. Fac-simile copy of Death Warrant of King Charles I.

Minister for Mines.—Geological maps.

Philip, Dr. Alex.—Oil painting, "Departure of New South Wales Contingent," by H. J. C. Mitchell.

Picturesque Atlas Co.—Series of views of Australia, by various artists.

Amateur Photographic Society.—Series of views near Sydney.

Selfe, Norman, C.E.—1. Album of American photographs. 2. Old prints.

Deffell, G. H.—1. One quarto volume of Cary's new map of England and Wales of 1794. 2. A view of London about the year 1560.

Sinclair, Sutherland.—1. Stereoscope and views of New York, River Hudson. 2. Four revolving albums of Scottish scenery.

Russell, H. C., F.R.S.E.—Photos. of the Flood in the River Darling.

Wilkinson, C. S., F.G.S.—Photos. of interior of Jenolan Caves.

Cox, Hon. G. H., M.L.C.—1. Ten photographic views of Mount Wilson. 2. Eight photographic views of Mulgoa, on the Nepean River.

Jackson, Rev. H. L.—Etchings (unframed).

Selfe, Norman.—1. Old prints of London Churches. 2. Copy of "Ecclesiastica Londini." 3. Old prints of Hampton Court Palace. 4. Old Remter Dish. 5. Leaden bust of Sir Isaac Newton.

Wright, Dr.—Original letter from Lord Nelson, conveying the account of the Battle of the Nile.

Dowling, Judge.—Old map of Sydney.

Adams, P. F., Surveyor-General.—Shields taken from trees originally marked by Surveyors, some in 1830.

Sinclair, Sutherland.—Figures of animals cut by Esquimaux, in bone.

Cox, Dr.—1. Two carved shells from New Caledonia. 2. Collection of cloths from the S. Sea Islands, collected on the three voyages of Captain Cook.

Wilkinson, C. S., Government Geologist.—1. Boomerangs from Bourke, N.S.W. 2. Carapace of tortoise from Madagascar. 3. Kava Bowl from Solomon Islands. 4. Warrior's club, Santa Cruz.

Amateur Photographic Society.—Views of New South Wales.

Cox, S. Herbert.—The Diamonds of New South Wales, illustrated by lantern views.

Hewett, T. E.—Experiments with polarised light.

Haswell, W. A., M.A., B.Sc. — Wax models of the development of —1. The serpula (a marine annelid worm). 2. The fresh-water crayfish. 3. The chick.

Hargrave, L.—Flying machines, the motion of fish, serpents, &c., based on the principle of the trochoided plane.

Ellis, Dr. H. A.—Pure cultivation of micro-organisms, bacteria, &c., and apparatus as described in Dr. Woodhead's book on the subject.

Katz, Dr. O.—Pure cultivation of micro-organisms, bacteria, &c., in Sydney water and ensilage.

Wilkinson, Dr. W. C.—Pure cultivation of micro-organisms, bacteria, &c., in solid media, Koch's method.

Haswell, W. A., M.A., B.Sc.—Series of specimens illustrating the marine zoology of Port Jackson.

Brazier, John, F.L.S.—Five specimens of recent trigonias.

Collie, Rev. Robt., F.L.S.—1. Rare ferns mounted on cards and in album. 2. Specimen of tin ore from N. England. 3. Fossils.

Whitelegge, T.—The mosses of N. S. Wales collected by.

Rigg, T. S. J.—Collection of ash and scoria, from recent volcanic eruption in N.Z.

Cox, S. Herbert, F.G.S.—Block of Alunite, and some alum manufactured from the stone.

Makin, G. E.—1. Silurian and carboniferous fossils. 2. Gems from Berrima.

Minister of Mines.—Collection of minerals and fossils from N. S. Wales.

Ratte, Felix.—Crystallized gold from N. Caledonia.

Australian Museum.—1. Saddle-shaped crystals of siderite from Sandhurst. 2. Tribachyocrinus corrugatas from the carboniferous sandstone of Illawarra.

Liversidge, Professor, F.R.S.E.—1. Gold ore, from Mount Lyall, Tasmania. 2. Gold ore, &c., from Fairfield, N. S. W. 3. Collection of N. S. W. silver minerals.

Haswell, W. A., M.A., B.Sc.—1. Cambridge rocking microtome section cutting machine. 2. Revolving table, for exhibiting series of sections (new).

Marano, Dr. V.—Pneumatic cabinet, for the mechanical treatment of phthisis.

Weisener, T. F.—1. Microscopes in process of construction (designed and manufactured by exhibitor). 2. Theodolite, 6". 3. Level, 16". 4. Pentagraph (improved). 5. The grinding of optical glass and manufacture of lenses (showing the various stages as conducted by the exhibitor). 6. Sighting tripod, with gemballs in suspension.

Board of Technical Education.—1. Tri-unial lantern and slides (Mr. Ramsay, operator). 2. Polariscope lantern and slides to illustrate the beautiful effects of polarised light (Mr. Hewett, operator).

Amateur Photographic Society.—Lantern slides, views near Sydney.

Kingsbury, H. & Co.—Telephones and various electrical apparatus.

Rothe, Dr. R.—1. Instruments for registering inhalation of breath, weight, height, &c. 2. Improved chairs and desks.

Madsen, H. F.—1. A silver on glass reflector, showing magnification of objects at the centre of curvature (made by the exhibitor). 2. Flat glasses for measuring minute films of air or silver (made by exhibitor).

Hoff, Dr. Aug.—Hoff's apparatus for photographing the larynx.

Russell, H. C., Government Astronomer.—1. A new clock, made after the model of the Post Office clock. 2. Photos. of instruments in the Observatory. 3. A new micrometer for comet work. 4. A very old telescope, on universal stand. 5. Experiments on dilitancy, showing the extraordinary behaviour of sand in an india-rubber bag.

Lichtner, E. F., optician—1. Photographic apparatus and instruments used in photography. 2. The miniature detective camera. 3. New camera for photographing on continuous roll of sensitised paper. 4. Field developing tent lenses, &c.

M'Donnell and Co., opticians.—A collection of scientific apparatus —Electric vacuum tubes, photographs, &c.

Poate, F.—Subtense theodolite by Troughton and Sims.

Selfe, Norman, C.E.—Steam engine indicator for giving continuous diagrams.

Liversidge, Professor, F.R.S.—Portable assay balance, improved by Mr. J. M. Smith, of Sydney.

Technological Museum lent an interesting collection of exhibits.

Etchings of objects of art, 1st series.

"Il Tesora di san Marco in Venezia," 1 vol.

"The art of the old English potter," 1 vol.

"Ornaments of domestic industry of Hungary," 1 vol.

"Ladies' old-fashioned shoes," 1 vol.

"Portfolios of Art," 26 parts.

"Journal of Indian Art," 13 Nos.

"Jeypore enamels," 1 vol.

The following is a list of Prof. Threlfall's exhibits and demonstrations —

I. An experiment for a rough estimation of the resistance of so-called insulating substances.

The method depends on an application of the induction balance.

The theory is complicated, but a statement will be written up near the apparatus.

The method is still being experimented on.

II. A galvanometer, designed in the Cavendish Laboratory, Cambridge, for measuring induction co-efficients. The peculiarities are—

(*a*) Sensitiveness is got by an astatic arrangement.

(*b*) The suspended parts are arranged, so that the "moment of inertia" may be easily found.

(*c*) Resistance of winding is small.

(*d*) Co-efficient of self-induction is very small.

(*e*) Adjustments are provided for placing the coils readily in the magnetic meridian, and measuring the torsion co-efficient of the suspending fibre.

III. A kathetometer, designed by Prof. Poynting, of Birmingham, and manufactured by the "Cambridge Scientific Instrument Company." The original improvements are—

(*a*) The scale does not support any of the weight of the moving parts.

(*b*) The telescope always moves parallel to itself because it is pressed at four points on a truly cylindrical surface.

(*c*) The object-glass of the telescope moves for focussing, and not the eye piece; this enables the line of collimation to be maintained in space with great accuracy.

(*d*) The scale is read directly by means of a microscope and micrometer.

(*e*) The arrangements for levelling are very perfect.

IV. Two reading microscopes, constructed from a design by Lord Rayleigh by the "Cambridge Scientific Instrument Company." One of these is furnished with an adjustment, designed by Professor Threlfall and H. Darwin, whereby it can be easily converted into a kathetometer microscope.

V. A dividing engine, by the "Société Genevoise pour la construction d'Instruments de Physique."

VI. Prof. Threlfall's model of Caldwell's automatic microtome. (This machine is a copy of the first instrument of the kind ever made, and described in "Balfour and Foster's Embryology," appendix.)

VII. Apparatus to illustrate Professor Threlfall's method of mounting series of sections on india-rubber films (Zoologisches Anzeiger, 1883).

VIII. Series to illustrate a method proposed by Prof. Threlfall for mounting sections without coverslip.

IX. Two "explosion gauges" used by Prof. Threlfall in his investigation on the direction of propagation of explosive effects in water. (Philosophical Magazine, March, 1886).

X. Sundry toys, *e.g.*, vacuum tubes. Diamond Leyden jar. Holtz machine, &c.

XI. Machine for grinding and polishing lenses and prisms. This machine is based on Nasmyth's model, and was designed and constructed by James Cook, F.R.A.S. It has already turned out a large number of mirrors, prisms, &c.

Dr. H. A. Ellis exhibited a collection of pure culture apparatus, as used in a biological research laboratory.

The undermentioned gentlemen exhibited microscopes:—W. A. Haswell, M.A., B.Sc., H. J. Bolding, T. F. Wiesener, T. Gaunt & Co., F. B. Kyngdon, T. Whitelegge, P. R. Pedley, H. O. Walker, L. H. Delarue, Dr. Morris, Dr. Wright, Thos. S. J. Rigg, Dr. Ellis, Dr. W. C. Wilkinson, Rev. H. L. Jackson, G. S. Hodgkinson, Dr. Mackellar, Professor Liversidge, F.R.S., and the two instruments belonging to the Society.

WEDNESDAY, 3 NOVEMBER, 1886.

C. Rolleston, C.M.G., President, in the Chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were duly elected ordinary members of the Society:—

Graham, James, M.A., M.B., C.M., Prince Alfred Hospital, Sydney.

Hozier, Charles H. S., F.R.C.S.I., Lic. K. and Q. Coll. Phys. (Irel.), Windsor, N.S.W.
Marshall, George A., M.B., Sydney.
Martin, Thomas M., L.R.C.P., L.R.C.S., (Edin.), Sydney.
Scott, Walter, M.A. (Oxon.), Professor of Classics, Sydney University.

The certificates of six new candidates were read for the second time, and of four for the first time.

The CHAIRMAN announced that the Society's Journal for 1885, Vol. XIX, had been delivered to all the members entitled to the same. He also stated that one of the members of the Society, Mr. Edward Ross Fairfax, had generously promised through Professor Liversidge the sum of £200 as a donation to the Building Fund on condition that the balance necessary to clear off the present debt of £800 be subscribed by the members before the end of the year.

On the motion of the Hon. G. A. Lloyd, M.L.A., seconded by Dr. Leibius, M.A., the best thanks of the Society were accorded to Mr. Fairfax for his kind and liberal offer.

Eighty-nine donations of books and periodicals were laid upon the table.

Mr. H. C. RUSSELL, B.A., F.R.S., read a paper—"Notes on the History of the Floods in the River Darling."

A discussion followed, in which the following gentlemen took part, viz. :—Messrs. J. B. Donkin, J. F. Mann, and C. Moore.

Mr. DONKIN exhibited a large number of photographs of the River Darling, taken during the recent tour of the Water Conservation Commission in that district.

Professor Liversidge laid upon the table an abstract of a paper by Professor E. H. RENNIE, M.A., D.Sc., of the Adelaide University, "Notes on the sweet principle of Smilax Glyeyphylla," and moved that it be taken as read. He stated that although the paper had been published in England, it was desirable that an abstract of the same should be published in the Colonies.

Professor LIVERSIDGE drew attention to the following correspondence respecting the alleged effects of lightning during the late volcanic eruptions at Tarewera in New Zealand, and explained that he did so on account of the great difficulty which always existed in correcting an erroneous statement of the kind. If a marvellous account of some perfectly simple phenomenon once goes the round of the papers, it is almost impossible to get the wrong version eradicated or the true accepted. The present matter was doubtless a case in point. Great publicity had been given to the alleged effects of the lightning, but probably no notice would be taken of the explanation, on account of its great simplicity and the entire absence of the marvellous; and in all probability the

matter would be quoted for many years in popular books on so-called science as one of the wonders of electricity :—

Bank of New Zealand, Auckland, 6th September, 1886.

Dear Sir,

Referring to our conversation about the coins which had been taken from a tin cash-box found in the house of Mr. Hazzard at Wairoa after the volcanic eruption and destruction of the house by fire, the owner of the coins will not part with them on any terms, as he attaches a sentimental value to them which cannot be measured in money. He has, however, kindly assented to my sending them for your inspection. The owner tells me there were originally four half-crowns and the half-sovereign all apparently attached by partial fusion, but they were accidentally allowed to fall from the hands of some one examining them, and the two bottom silver coins became detached. On the exterior of the outer silver coin there was no appearance of golden colour, but when the two became detached the appearance of gold, which you will see on the outer surface of the third half-crown, gave rise to the idea that the fusion was the effect of lightning, and that by some electrical action portion of the gold had been precipitated through the silver. It would be very interesting to know whether the yellow colouring on the outer half-crown is gold, and the owner is quite willing that a small section of it should be, if necessary, scraped off with the view of testing it. It is only on my pledge that otherwise the coins will not be disturbed that he has allowed me the temporary use of them. I may tell you that Professor Brown here has no faith in the gold-transmission theory, and believes the appearance is due to the action of fire, and is not unusual under such circumstances. When you have had sufficient opportunity to satisfy yourself by examination, be good enough to return the coins to me.

Yours very truly,
D. L. MURDOCH.

A. Liversidge, Esq., Sydney.

The University, Sydney, 27 September, 1886.

My dear Sir,

I am much obliged to you for the opportunity of examining the coins from the cash-box which had been found in Mr. Hazzard's house at Wairoa after the eruption and destruction of the house by fire.

I have carefully examined the coins, and find that they do not show any trace of fusion. One of the half-crowns was separate, and the other two had been stuck together with some gum ; the half-sovereign was merely slightly adherent by a film of oxide of copper ; the yellow colour, mistaken for gold which had been forced through the half-crowns, consists merely of a thin film of oxide of copper ; the thicker films give a black appearance to other parts of the silver coins. Both the yellow colour and the black crust are at once removed by strong ammonia solution, which would not be the case with gold, and a pure white silver surface is left. On placing two half-crowns together and heating them in the flame of a spirit lamp I produced the same effects exactly : the outer portions of the half-crowns were blackened, but the central parts, where the air had less access, presented a golden appearance. I think all the effects seen in the coins would be produced merely by the burning down of the house, and they do not in any special way point to the action of lightning, which would probably have fused them into one mass, whereas they have not been fused, but merely heated to a sufficient temperature to oxidize the copper of the alloy, by which the coins have apparently been cemented together.

I return the coins in a sealed packet herewith. With thanks and kind regards,

I am, yours very truly,
A. LIVERSIDGE.

D. L. Murdoch, Esq.

Professor LIVERSIDGE, F.R.S., read a paper "Notes on Minerals," illustrated by a large collection of specimens.

Some remarks were made by Mr. C. S. Wilkinson.

Mr. H. C. RUSSELL, B.A., F.R.S., read a paper "On a new Filar Micrometer."

About thirty members were present.

WEDNESDAY, 1 DECEMBER, 1886.

C. ROLLESTON, C.M.G., President, in the Chair.

The minutes of the last meeting were read and confirmed.

The following gentlemen were duly elected ordinary members of the Society :—

Bowker, Robert S., L.R.C.P., Edin., M.R.C.S., Eng., Sydney.
Carey, John R., St. Leonards.
Crago, W. H., L.R.C.P., Lond., M.R.C.S., Eng., Sydney.
Haslam, John, Sydney.
Hutchinson, W. A., Balmain.
Redfearn, William, Burwood,

and the following as corresponding member, viz.,

Professor Jules Marcou, F.G.S., Cambridge, Mass., U.S. America.

The certificates of four new candidates were read for the second time, and of two for the first time.

It was resolved that Messrs. W. C. W. Bartels and H. O. Walker be appointed Auditors for the current year.

One hundred and ninety-five donations of books and periodicals, eight charts, and six portfolios of geological maps, were laid upon the table.

Professor THRELFALL, B.A. (Cantab.), read a paper—"Notes on the Theory of Dissociation of Gases."

Mr. Russell made some remarks to which Professor Threlfall replied.

The Hon. Secretary in the absence of the author read a paper by Mr. JOHN TEBBUTT, F.R.A.S., &c., "Results of the Observations of Comets Fabry, Barnard, and Brooks (No. 1), 1886, at Windsor, N.S.W."

Some remarks were made by Mr. Russell.

Professor LIVERSIDGE, F.R.S., read the following papers :—1. "Notes on some Rocks and Minerals from New Guinea and Polynesian Islands." 2. "Notes on some N.S.W. Silver and

other Minerals." 3. "On the composition of Pumice from the Pacific."

Remarks were made by the Hon. G. A. Lloyd and Mr. C. S. Wilkinson.

Professor WARREN, A.M.I.C.E., read a paper "On the Strength and Elasticity of Iron-bark Timber as applied to works of construction."

A short discussion (owing to the lateness of the hour) followed, in which Messrs. C. Moore, J. Trevor Jones, and J. A. MacDonald, took part.

Mr. H. C. RUSSELL, B.A., F.R.S., read a paper—"Notes upon Floods in Lake George."

About thirty members were present.

ADDITIONS

TO THE

LIBRARY OF THE ROYAL SOCIETY OF NEW SOUTH WALES.

DONATIONS—1886.

(The names of the Donors are in *Italics*.)

TRANSACTIONS, JOURNALS, REPORTS, &c.

ABERDEEN :—The Aberdeen University Calendar for the academical year 1886-87. *The University.*

ADELAIDE :—

Central Board of Health (South Australia)—
Acts relating to Public Health, V.R. No. 22, 1873; No. 56, 1876; No. 316, 1884.
Extract from the Orders and Regulations published in the *Government Gazette*, 13 Aug., 1885.
How to prevent the spread of Scarlet Fever.
Regulations *re* Earth Closets.
Typhoid Fever. *The Central Board of Health.*

Report of the Progress and Condition of the Botanic Garden and Government Plantations during 1885. *The Government Botanist.*

The Forest Flora of South Australia, by J. E. Brown, F.L.S. Part VII. *The Government Printer.*

Report of the Board of Governors of the Public Library, Museum, and Art Gallery of South Australia for 1885-86. *The Board.*

Transactions and Proceedings and Report of the Royal Society of South Australia. Vol. VIII, 1884-85. *The Society.*

AMSTERDAM :—Verslagen en Mededeelingen der Koninklijke Akademie van Wetenschappen, Reeks 3. Deel. I, 1885.

Jaarboek van de Koninklijke Akademie van Wetenschappen, 1884. *The Academy.*

Bijdragen tot de Dierkunde Aflevering 13e Gedeelte 4e, 1886. *Société Royale de Zoologie.*

Revue Coloniale Internationale. Tome II, Nos. 2-6, Feb.-June, 1886.
" III, " 1-6, July-Dec., "
L'Association Coloniale Neerlandaise à Amsterdam.

AUCKLAND :—Report of the Auckland Institute and Museum for 1884-85. *The Institute.*

BALLAARAT :—Annual Report of the School of Mines for the year 1885. *The School of Mines.*

BALTIMORE (MARYLAND) :—
Johns Hopkins University—
American Chemical Journal. Vol. VI, No. 6.
" " " " VII, Nos. 1, 5, 6.
American Journal of Mathematics. Vol. VII, Nos. 3 and 4.
" " " " VIII, " 1 and 2.
" " " " IX, No. 1.
American Journal of Philology. Vol. V, No. 4. Whole No. 20.
" " " " VI, " 1. " " 21,
" No. 4." Whole No. 24.
Historical and Political Studies (Third Series). Parts 2 & 3, 4, 5, 6 & 7, 9 & 10.
" " " (Fourth "). Parts 1, 2, & 3.
Proceedings of the Trustees of the John F. Slater Fund for the Education of Freedmen, 1884.
Studies from the Biological Laboratory. Vol. II, No. 3.
" " " " III, Nos. 3 and 5.
The Maryland Historical Society. Annual Report of the Officers and Committees for 1884–1885.
University Circulars, Vol. V, Nos. 45, 46, and 47.
The Johns Hopkins University.

BATAVIA :—Koninklijke Natuurkundige Vereeniging in Nederlandsch-Indië Natuurkundig Tijdschrift. Deel. XLV. (Serie achtste.) Deel. VI, 1886.
The Society.

BERGEN :—
Bergens Museums. Aarsberetning for 1885.
Bidrag til Myzostomernes Anatomi og Histologi af Fridtjof Nansen, 1885.
The Museum.

BERLIN :—Königlich Preussische Akademie der Wissenschaften zu Berlin. Sitzungsberichte. Nos. 1 to 22. 7 Jan. to 15 April, 1886.
The Academy.

BERNE :—Geographische Gesellschaft von Bern. Jahresbericht Vol. VII, 1884–1885.
The Society.

BOMBAY :—Natural History Society of Bombay. Journal. Vol. I, Nos. 1, 2, and 3.
The Society.

BOSTON (MASS.) :—
American Academy of Arts and Sciences—
Proceedings. (New Series.) Vol. XII, Whole Series, Vol. XX.
" " " XIII, " " XXI,
Part 1.
The Academy.
Boston Society of Natural History—
Memoirs. Vol. I. Parts 2, 3, 4.
" " II. " II, Nos. 1, 2, 4.
" " " " III, " 1, 2, 3, 5.
" " " " IV, " 1, 2, 3, 4.
" " III. " I, " 11.
Occasional Papers. No. 1. 1869.
" " " 2. 1875.
Proceedings. Vol. XIV.
" " XV. Parts 1–4.
" " XVI. " 1–4.
" " XVII. " 1–4.
" " XVIII. " 1 and 2.
" " XXII. " 4.
" " XXIII. " 1.
The Society.

BREMEN :—Naturwissenschaftlicher Verein zu Bremen. Abhandlungen. Band IX, Heft 3.
The Society.

BRISBANE :—
Acclimatisation Society of Queensland—
Twentieth Report of the Council for the year 1885. *The Society.*
Colonial Secretary, Queensland—
Model By-laws under The Health Act of 1884—Common Lodging Houses.
The Health Act of 1884. *The Colonial Secretary.*
Geographical Society of Australasia (Queensland Branch)—
Proceedings. Vol. I. First Session, 1885-86.
" " II, Part 1. Second Session, 1886-87.
Report of the Second Ordinary Meeting, March, 1886. *The Society.*
Royal Society of Queensland—
Notes on a Great Visitation of Rats in the North and North-Western Plain Country of Queensland in 1869 and 1870; by E. Palmer, M.L.A.
Notes on Queensland Ants; by Henry Tryon.
Proceedings. Vol. 2, Parts 1 and 2. 1885. *The Society.*

BRISTOL :—Bristol Naturalists' Society—
List of Members and Annual Report for the year ending 30 April, 1886.
Proceedings. (New Series.) Vol. V, Part 1. 1885-6. *The Society.*

BRUSSELS :—
Musée Royal d'Histoire Naturelle de Belgique—
Bulletin. Tome III. Nos. 1, 2, 3, 4. 1884-1885.
" " IV. " 1, 2, 3. 1885-1886. *The Museum.*
Société Royale Malacologique de Belgique—
Annales. Tome XX. (Third Series.) Tome V. 1885.
Procès Verbal. Tome XIV (1 Aug. to 5 Dec., 1885).
" " XV (9 Jan. to 4 July, 1886).
Status. (Second Edition.) 1886. *The Society.*

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Engravings, &c.

Etched portrait of Dr. Charles Darwin, M.A., F.R.S., &c., by Flameng.
Etched portrait of Professor Huxley, F.R.S., by Flameng.

Donations to the Society's Cabinets, 1886.

Autographs Letters (17) from Eminent Men (addressed to the late Professor Smith, C.M.G., M.L.C., &c.). *Mrs. Smith.*
Grindstone used by the Aborigines for crushing seeds for food purposes; from Mumblebone on the Lower Macquarie. *H. E. Kater.*
Slides of Microscopic Objects (5). *W. H. H. Lane.*
Stage Micrometer ruled on glass to the 25,000th of an inch, by Fasoldt of New York. *W. H. H. Lane.*

EXCHANGES AND PRESENTATIONS

MADE BY THE

ROYAL SOCIETY OF NEW SOUTH WALES,

1886.

The Journal and Proceedings of the Royal Society of N.S.W. for 1885 vol. xix, has been distributed as follows :—

The publications for Europe were sent through Messrs. Trübner & Co., London; those for the United States of America and Canada to the care of Messrs. Wesley & Co., Agents for the Smithsonian Institution; the packages for French Societies and Institutions were forwarded through the Ministère de l'Instruction Publique des Beaux Arts et des Cultes; and in all other cases, not otherwise provided for, the parcels have been transmitted by book post.

The Smithsonian Institution, Washington, U.S.A., and Messrs. Trübner & Co., 57, Ludgate Hill, London, E.C., have kindly undertaken to receive and forward to Sydney all communications and parcels intended for the Royal Society of New South Wales.

Presentations to the Society are acknowledged by letter, and in the Society's Annual Volume.

* Exchanges of Publications have been received from the Societies and Institutions distinguished by an asterisk.

ARGENTINE REPUBLIC.

1. **Cordoba.**—*Academia Nacional de Ciencias.

AUSTRIA.

2. **Prague.**—*Königlich böhmische Gesellschaft der Wissenschaften.
3. **Trieste.**—*Società Adriatica di Scienze Naturali.
4. **Vienna.**—*Anthropologische Gesellschaft.
5. „ *Kaiserliche Akademie der Wissenschaften.
6. „ *K. K. Central-Anstalt für Meteorologie und Erdmagnetismus.
7. „ *K. K. Geographische Gesellschaft.
8. „ *K. K. Geologische Reichsanstalt.
9. „ *K. K. Naturhistorische Hofmuseum.
10. „ *K. K. Zoologisch-Botanische Gesellschaft.
11. „ *Œsterreichische Gesellschaft für Meteorologie.

BELGIUM.

12. **Brussels.**—*Académie Royale des Sciences, des Lettres, et des Beaux Arts.
13. „ *Musée Royal d'Histoire Naturelle de Belgique.
14. „ *Observatoire Royal de Bruxelles.
15. „ *Société Royale Malacologique de Belgique.
16. **Liege.**—*Société Géologique de Belgique.
17. „ *Société Royale des Sciences.
18. **Luxembourg.**—*Institut Royale Grand-ducal de Luxembourg.
19. **Mons.**—*Société des Sciences, des Arts et des Lettres du Hainaut.

BRAZIL.

20. **Rio de Janeiro.**—*L'Observatoire Impérial de Rio de Janeiro.

DENMARK.

21. **Copenhagen.**—*Société Royale des Antiquaires du Nord.

FRANCE.

22. **Bordeaux.**—*Académie Nationale des Sciences, Belles-Lettres et Arts.
23. **Caen.**—*Académie Nationale des Sciences, Arts et Belles-Lettres.
24. **Dijon.**—*Académie des Sciences, Arts et Belles-Lettres.
25. **Lille.**—*Société Géologique du Nord.
26. **Montpellier.**—*Académie des Sciences et Lettres.
27. **Paris.**—*Académie des Sciences de l'Institut de France.
28. „ *Depôt des Cartes et Plans de la Marine.
29. „ Ecole Nationale des Mines.
30. „ Ecole Normale Supérieure.
31. „ *Ecole Polytechnique.
32. „ Editor, *Cosmos les Mondes.*
33. „ Editor, *Revue des Cours Scientifiques.*
34. „ Faculté de Médecine de Paris.
35. „ *Faculté des Sciences de la Sorbonne.
36. „ Jardin des Plantes.
37. „ *L'Observatoire de Paris.
38. „ *Musée d'Histoire Naturelle.
39. „ *Ministère de l'Instruction Publique des Beaux Arts, et des Cultes.
40. „ Société Botanique.
41. „ *Société d'Anatomie.
42. „ *Société d'Anthropologie de Paris.
43. „ *Société de Biologie.
44. „ Société de Chirurgie de Paris.
45. „ *Société d'Encouragement pour l'Industrie Nationale.
46. „ *Société de Géographie.
47. „ *Société Entomologique de France.
48. „ Société Géologique de France.
49. „ Société Météorologique de France.
50. „ *Société Française de Minéralogie.
51. „ *Société Philotechnique.
52. „ Société de Physique.
53. „ *Société Zoologique de France.
54. **Saint Etienne.** —*Société de l'Industrie Minérale.
55. **Toulouse.**—*Académie des Sciences Inscriptions et Belles-Lettres.

GERMANY.

56. **Bremen.**—*Naturwissenschaftlicher Verein zu Bremen.
57. **Berlin.**—Deutsche Chemische Gesellschaft.
58. „ *Königlich Preussische Akademie der Wissenschaften.
59. **Bonn.**—*Naturhistorischer Verein der Preussischen Rheinlande und Westphalens in Bonn.
60. **Braunschweig.**—*Verein für Naturwissenschaft zu Braunschweig.

61. **Carlsruhe.**—*Grossherzogliches Polytechnikum zu Carlsruhe.
62. „ *Naturwissenschaftlicher Verein zu Carlsruhe.
63. **Cassel.**—*Verein fur Naturkunde.
64. **Chemnitz.**—*Naturwissenschaftliche Gesellschaft zu Chemnitz.
65. **Dresden.**—*Das Statistische Bureau des Ministeriums des Innern zu Dresden.
66. „ *General-Direction der Königlichen Sammlungen für Kunst und Wissenschaft zu Dresden.
67. „ *Königliches Mineralogische Museum.
68. „ *Öffentliche Bibliothek.
69. „ *Verein für Erdkunde zu Dresden.
70. **Elberfeld.**—*Naturwissenschaftlicher Verein in Elberfeld.
71. **Frankfurt a/M.**—*Senckenbergische Naturforschende Gesellschaft in Frankfurt a/M.
72. **Freiberg (Saxony).**—Die Berg Akademie zu Freiberg.
73. „ *Naturforschende Gesellschaft zu Freiberg.
74. **Görlitz.**—*Naturforschende Gesellschaft in Görlitz.
75. **Göttingen.**—*Königliche Gesellschaft der Wissenschaften in Göttingen.
76. **Halle A.S.**—*Die Kaiserlich Deutsche Leopoldinisch—Carolinische Akademie der Naturforcher zu Halle A.S. (Prussia).
77. **Hamburg.**—*Die Geographische Gesellschaft in Hamburg.
78. „ *Naturhistorisches Museum der freien Stadt Hamburg.
79. „ *Verein für Naturwissenschaftliche Unterhaltung in Hamburg.
80. **Heidelberg.**—*Naturhistorisch Medicinischer Verein Heidelberg.
81. **Jena.**—*Medicinisch Naturwissenschaftliche Gesellschaft.
82. **Königsberg.**—*Königliche Physikalisch-ökonomische Gesellschaft.
83. **Leipzig (Saxony).**—*Koniglich Sächsische Gesellschaft der Wissenschaften.
84. **Marburg.**—*Gesellschaft zur Beförderung der gesammten Naturwissenschaften in Marburg.
85. „ *The University.
86. **Metz.**—*Verein für Erdkunde zu Metz.
87. **Mulhouse.**—*Industrial Society.
88. **Munchen.**—*Königlich Baierische Akademie der Wissenschaften in München.
89. **Stuttgart.**—*Königliches Stati-tisches Landesamt.
90. „ *Verein für Vaterländische Naturkunde in Württemberg.

GREAT BRITAIN AND THE COLONIES.

91. **Birmingham.**—*Birmingham and Midland Institute.
92. „ *Birmingham Philosophical Society.
93. **Bristol.**—*Bristol Naturalists' Society.
94. **Camborne.**—*Mining Association and Institute of Cornwall.
95. **Cambridge.**—*Philosophical Society.
96. „ *Public Free Library.
97. „ Union Society.
98. „ University Library.

99. **Dudley.**—Dudley and Midland Geological and Scientific Society and Field Club.
100. **Leeds.**—*Conchological Society.
101. „ *Philosophical and Literary Society.
102. „ *Yorkshire College.
103. **Liverpool.**—*Literary and Philosophical Society.
104. **London.**—*Agent-General (two copies).
105. „ *Anthropological Institute of Great Britain and Ireland.
106. „ *British Museum (two copies).
107. „ Chemical Society.
108. „ Colonial Office, Downing-street.
109. „ Editor, *Cassell's Encyclopædia*.
110. „ Entomological Society.
111. „ *Geological Society.
112. „ Institute of Chemistry of Great Britain and Ireland.
113. „ *Institution of Civil Engineers.
114. „ *Institution of Naval Architects.
115. „ Library, South Kensington Museum.
116. „ *Linnean Society.
117. „ *London Institution.
118. „ *Lords Commissioners of the Admiralty.
119. „ *Lord Lindsay's Observatory.
120. „ *Meteorological Office.
121. „ *Mineralogical Society.
122. „ Museum of Practical Geology.
123. „ Patent Office Library.
124. „ *Pharmaceutical Society of Great Britain.
125. „ *Physical Society, South Kensington Museum.
126. „ *Quekett Microscopical Club.
127. „ *Royal Agricultural Society of England.
128. „ *Royal Asiatic Society of Great Britain and Ireland.
129. „ *Royal Astronomical Society.
130. „ *Royal College of Physicians.
131. „ *Royal College of Surgeons.
132. „ *Royal Colonial Institute.
133. „ *Royal Geographical Society.
134. „ *Royal Historical Society.
135. „ *Royal Institution of Great Britain.
136. „ *Royal Meteorological Society.
137. „ *Royal Microscopical Society.
138. „ *Royal School of Mines.
139. „ *Royal Society.
140. „ Royal Society of Literature.
141. „ *Royal United Service Institution.
142. „ Society of Arts.
143. „ University of London.
144. „ War Office—(Intelligence Branch).
145. „ *Zoological Society.
146. **Manchester.**—*Geological Society.
147. „ *Literary and Philosophical Society.
148. „ *Owens College.
149. **Middlesboro'.**—*Iron and Steel Institute.
150. **Newcastle-upon-Tyne.**—*Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne.
151. „ „ *North of England Institute of Mining and Mechanical Engineers.
152. „ „ *Society of Chemical Industry.

153. **Oxford.**—*Ashmolean Library.
154. „ *Bodleian Library.
155. „ *Radcliffe Library.
156. „ *Radcliffe Observatory.
157. **Penzance.**—*Royal Geological Society of Cornwall.
158. **Plymouth.**—*Plymouth Institution, and Devon and Cornwall Natural History Society.
159. **Windsor.**—The Queen's Library.

CAPE OF GOOD HOPE.

160. **Cape Town.**—*South-African Philosophical Society.

DOMINION OF CANADA.

161. **Halifax (Nova Scotia).**—*Nova Scotia Institute of Natural Science.
162. **Hamilton (Canada West).**—*Hamilton Association.
163. **Montreal.**—*Natural History Society of Montreal.
164. **Ottawa.** -*Geological and Natural History Survey of Canada.
165. „ *Royal Society of Canada.
166. „ The Ottawa Literary and Scientific Society.
167. **Toronto.**—*Canadian Institute.
168. **Winnipeg**—*Manitoba Historical and Scientific Society.

INDIA.

169. **Calcutta.**—*Asiatic Society of Bengal.
170. „ *Geological Survey of India.

IRELAND.

171. **Dublin.**—*Royal Dublin Society.
172. „ *Royal Geological Society of Ireland.
173. „ *Royal Irish Academy.

MAURITIUS.

174. **Port Louis.**—Royal Society of Arts and Sciences.
175. „ Société d'Acclimatation.

NEW SOUTH WALES.

176. **Sydney.**—Australian Club.
177. „ *Australian Museum.
178. „ *Free Public Library.
179. „ *Linnean Society of New South Wales.
180. „ *Mining Department.
181. „ *Observatory.
182. „ School of Arts.
183. „ Technological Museum.
184. „ Union Club.
185. „ *University.

NEW ZEALAND.

186. **Auckland.**—*Auckland Institute.
187. **Christchurch.**—Philosophical Institute of Canterbury.
188. **Dunedin.**—Otago Institute.
189. **Wellington.**—*Colonial Museum.
190. „ *New Zealand Institute.
191. „ Philosophical Society.

QUEENSLAND.

192. **Brisbane.**—*Acclimatization Society of Queensland.
193. „ *Geographical Society of Australasia (Queensland Branch).
194. „ Parliamentary Library.
195. „ *Royal Society of Queensland.

SCOTLAND.

196. **Aberdeen.**—*Dun Echt Observatory, Earl of Crawford and Balcarres.
197. „ *University.
198. **Edinburgh.**—*Editor, *Encyclopædia Britannica*, Messrs. A. and C. Black.
199. „ *Edinburgh Geological Society.
200. „ *Royal Botanic Garden.
201. „ *Royal Observatory.
202. „ *Royal Physical Society.
203. „ *Royal Society.
204 „ *Scottish Geographical Society.
205. „ *University.
206. **Glasgow.**—*Geological Society of Glasgow.
207. „ *University.

SOUTH AUSTRALIA.

208. **Adelaide.**—*Government Botanist.
209. „ *Government Printer.
210. „ *Observatory.
211. „ *Royal Society of South Australia.
212. „ *Public Library, Museum and Art Gallery of South Australia.
213. „ *University.

TASMANIA.

214. **Hobart.**—*Royal Society of Tasmania.

VICTORIA.

215. **Ballarat.**—*School of Mines and Industries.
216. **Melbourne.**—Eclectic Association.
217. „ *Field Naturalists' Club of Victoria.
218. „ *Government Botanist.
219. „ *Government Statist.
220. „ *Mining Department.
221. „ *Observatory.
222. „ *Public Library.
223. „ *Registrar-General.
224. „ *Royal Society of Victoria.
225. „ *University.
226. „ *Victorian Institute of Surveyors.

HUNGARY.

227. **Bistritz (in Siebenbürgen).**—*Direction der Gewerbeschule.
228. **Zagreb (Agram).**—*Société Archéologique.

ITALY.

229. **Bologna.**—*Accademia delle Scienze dell' Istituto di Bologna.
230. „ Università di Bologna.
231. **Florence.**—*Società Entomologica Italiana.
232. „ *Società Italiana di Antropologia e di Etnologia.
233. „ *Società Africana d'Italia (Sezione Fiorentina).
234. **Genoa.**—*Museo Civico di Storia Naturale.
235. **Milan.**—Reale Istituto Lombardo di Scienze Lettere ed Arti.
236. „ Società Italiana di Scienze Naturali.
237. **Modena.**—*Académie Royale des Sciences, Lettres et Arts de Modène.
238. **Naples.**—*Società Africana d'Italia.
239. „ *Società Reale di Napoli (Accademia delle Scienze fisiche e matematiche).
240. „ *Stazione Zoologica (Dr. Dohrn).
241. **Palermo.**—*Accademia Palermitana di Scienze Lettere ed Arti.
242. „ Reale Istituto Tecnico.
243. **Pisa.**—*Società Toscana di Scienze Naturali.
244. **Rome.**—*Accademia Pontificia de'Nuovi Lincei.
245. „ *Biblioteca e Archivio Tecnico (Ministero dei Lavori Pubblico).
246. „ Circolo Geographica d'Italia.
247. „ Osservatorio del Astronomico Collegio Romano.
248. „ *R. Accademia dei Lincei.
249. „ *R. Comitato Geologico Italiano.
250. „ *Società Geografica Italiana.
251. **Siena.**—R. Accademia de Fisiocritici.
252. **Turin.**—Reale Accademia delle Scienze.
253. „ Regio Osservatorio della Regia Università.
254. **Venice.**—*Reale Istituto Veneto di Scienze, Lettere ed Arti.

JAPAN.

255. **Yokohama.**—*Asiatic Society of Japan.

JAVA.

256. **Batavia.**—*Kon. Natuurkundige Vereeniging in Nederl Indië.

NETHERLANDS.

257. **Amsterdam.**—*Académie Royale des Sciences.
258. „ *Association Coloniale Néerlandaise.
259. „ *Société Royale de Zoologie.
260. **Harlem.**—*Bibliothèque de Musée Teyler.
261. „ *Société Hollandaise des Sciences.

NORWAY.

262. **Bergen.**—*Museum.
263. **Christiania.**—*Kongelige Norske Fredericks Universitet.
264. „ *Videnskabs-Selskabet i Christiania.

ROUMANIA.

265. **Bucharest.**—*Institutul Meteorologic al României.

RUSSIA.

266. **Helsingfors.**—*Société des Sciences de Finlande.
267. **Moscow.**—*Société Impériale des Naturalistes.
268. „ *Société Impériale des Amis des Sciences Naturelles d'Anthropologie et d'Ethnographie à Moscow. (Section d'Anthropologie.)
269. **St. Petersburgh.**—*Academie Impériale des Sciences.
270. „ *Comité Géologique—Institut des Mines.

SPAIN.

271. **Madrid.**—Instituto geographico y Estadistico.

SWEDEN.

272. **Stockholm.**—*Kongliga Svenska Vetenskaps-Akademien.
273. „ *Kongliga Universitetet.

SWITZERLAND.

274. **Berne.**—*Société de Géographie de Berne.
275. **Geneva.**—*Institut National Genèvois.
276. **Lausanne.**—*Société Vaudoise des Sciences Naturelles.
277. **Neuchatel.**—*Société des Sciences Naturelles.

STRAITS SETTLEMENT.

278. **Singapore.**—*Royal Asiatic Society.

UNITED STATES OF AMERICA.

279. **Albany.**—*New York State Library, Albany.
280. **Annapolis (Md.)**—Naval Academy.
281. **Baltimore.**—*Johns Hopkins University.
282. **Beloit (Wis.)**—*Chief Geologist.
283. **Boston.**—*American Academy of Arts and Sciences.
284. „ *Boston Society of Natural History.
285. **Buffalo.**—*Buffalo Society of Natural Sciences.
286. **Cambridge.**—*Cambridge Entomological Club.
287. „ *Museum of Comparative Zoology, Harvard College.
288. **Chicago.**—Academy of Sciences.
289. **Cincinnati.**—*Cincinnati Society of Natural History.
290. **Coldwater.**—Michigan Library Association.
291. **Davenport (Iowa).**—*Academy of Natural Sciences.
292. **Denver.**—*Colorado Scientific Society.
293. **Hoboken (N.J.)**—*Stevens' Institute of Technology.
294. **Iowa City (Iowa).**—*Director Iowa Weather Service.
295. **Minneapolis.**—*Minnesota Academy of Natural Sciences.
296. **Newhaven (Conn.)**—*Connecticut Academy of Arts.
297. **New York.**—*American Chemical Society.
298. „ *American Geographical Society.
299. „ *Editors "*Science*."
300. „ *New York Academy of Sciences.
301. „ *New York Microscopical Society.
302. „ *School of Mines, Columbia College.

303. **Philadelphia.**—*Academy of Natural Science.
304. „ *American Entomological Society.
305. „ *American Philosophical Society.
306. „ *Franklin Institute.
307. „ *Second Geological Survey of Pennsylvania.
308. „ *Zoological Society of Philadelphia.
309. **Salem (Mass.)**—*American Association for the Advancement of Science.
310. „ *Essex Institute.
311. „ *Peabody Academy of Sciences.
312. **St. Louis.**—*Academy of Science.
313. **San Francisco.**—*California Academy of Sciences.
314. „ *California State Mining Bureau.
315. **Washington.**—*American Medical Association.
316. „ *Bureau of Education (Department of the Interior).
317. „ *Bureau of Ethnology.
318. „ *Bureau of Navigation (Navy Department).
319. „ *Chief of Engineers (War Department).
320. „ *Chief Signal Officer (War Department).
321. „ *Commissioner of Agriculture.
322. „ *Director of the Mint (Treasury Department).
323. „ *Hydrographic Office.
324. „ *National Academy of Sciences.
325. „ *Office of Indian Affairs (Department of the Interior).
326. „ *Ordnance Department.
327. „ *Philosophical Society.
328. „ *Secretary (Department of the Interior).
329. „ *Secretary (Navy Department).
330. „ *Secretary (Treasury Department).
331. „ *Smithsonian Institution.
332. „ *Surgeon-General (U. S. Army).
333. „ *U. S. Coast and Geodetic Survey (Treasury Department).
334. „ *U. S. Geological Survey.
335. „ *U. S. National Museum (Department of the Interior).
336. „ U. S. Patent Office.
337. „ *War Department.

Number of Publications sent to	Great Britain...	...	82
„	India and the Colonies	...	53
„	America ...	...	60
„	Europe ...	...	135
„	Asia, &c. ...	...	2
„	Editors of Periodicals	...	5
	Total ...	...	337

A. LIVERSIDGE,
F. B. KYNGDON, } Hon. Secretaries.

The Society's House, Sydney,
30 *September*, 1886.

PROCEEDINGS OF THE SECTIONS.

(IN ABSTRACT.)

PROCEEDINGS OF THE SECTIONS.

(IN ABSTRACT.)

MICROSOCOPICAL SECTION.

Preliminary Meeting, held 12th APRIL, 1886.

Mr. P. R. Pedley in the Chair.

It was decided to hold the meetings on the evenings of the second Monday in each month. Chairman: Mr. P. R. Pedley. Secretary: Mr. F. B. Kyngdon. Committee: Dr. Morris, Dr. Wright, Mr. Whitelegge, and Mr. Weisener.

10 MAY, 1886.

Mr. Pedley in the Chair.

The following were exhibited:—

A photograph of the late R. B. Tolles, the celebrated objective maker of Boston, U.S. (Dr. Wright.)

Powell and Lealand's new $\frac{1}{12}$ hom. objective N.A. 1·5=161°. (Dr. Morris.)

Swift's best challenge Binocular Microscope. (Mr. Macdonnell.)

Powell and Lealand's $\frac{1}{8}$ hom. objective N.A. 1·29=116°. (Mr. Macdonnell.)

Winkel's Students' Microscope and $\frac{1}{11}$ hom. objective N.A. 1·25 =110°. (Dr. Katz.)

Double-stained slides of Bacillus of Tuberculosis, Glanders, &c., and Jordan's staining fluids. (Dr. Katz.)

A Coralline from Port Jackson. (Mr. Macdonnell.)

A fresh-water gathering, rich in pond life. (Mr. Whitelegge.)

A paper was read by Dr. Morris on the Maize-blight, illustrated by several preparations.

Mr. Whitelegge explained a method of readily mounting living fresh-water organisms, such as *Rhizopods*, by means of a weak solution of osmic acid.

Dr. Wright presented a copy to the Society of Chase and Habirshaw's Catalogue of the Diatomaceæ.

14 JUNE, 1886.

Mr. Macdonnell in the Chair.

The following were exhibited:—

Several students' microscopes by London makers. (Mr. Weisener.)

A series of slides from the Technical College. (Mr. Ramsay.)
A diatom from Cook's River, *Himantidium*. (Mr. Macdonnell.)
Slides of Hydroid Zoophytes with tentacles expanded; also, diatoms from Bondi.

Mr. WHITELEGGE explained his method of mounting Zoophytes with their tentacles expanded by means of the addition of a minute quantity of chloroform.

12 JULY, 1886.

Mr. PEDLEY in the Chair.

The following were exhibited :—
1in. objective by Green (for many years with Tolles), having an angle of 54°, and fitted with a conical front. (Dr. Wright.)
A slide of Bacillus of Tubercle. (Dr. Wright.)
Two new Monocular microscopes by a London maker. (Mr. Weisener.)
The peristome of a moss, also the circulation in the "chara." (Mr. Whitelegge.)

9 AUGUST, 1886.

Mr. PEDLEY in the Chair.

The following were exhibited :—
A copy of "Crookshank's Bacteriology." (Dr. Wright.)
A beautiful Radiolaria from Port Jackson. (Mr. Macdonnell.)
A parasitical rotifer, *Notomata Parasita*, from a fresh-water pond, Botany.
A slide of diatoms from Lake Wendouree (Vic.) (Mr. Sharp.)
Mr. W. H. H. LANE presented to the Society a Micrometer, by Fasoldt, of New York, ruled to the 25·000 inch.

13 SEPTEMBER, 1886.

Mr. PEDLEY in the Chair.

The following were exhibited :—
Brown and Sharp's Co. Micrometer for cover glass measurement- (Mr. W. H. H. Lane.)
Volcanic dust from Tarawera. (Mr. Rigg.)
Nachet's Microscopes. (Messrs. Gaunt.)
Spencer's 1 inch objective 40°; Spencer's $\frac{1}{6}$ hom. objective N.A. 1·35 with gold-plated fronts to resist acids. (Dr. Wright.)
Dr. MORRIS brought Tolles' $\frac{1}{6}$ hom. objective N.A. 1·52 to compare with Spencer's on a difficult slide of A. Pellucida. The performance of both these fine glasses was of unusual excellence, and as near as could be equal.
Mr. W. H. H. LANE presented to the Society a copy of the 1883 edition of the Micrographic Dictionary.

10 OCTOBER, 1886.

Mr. PEDLEY in the Chair.

The following were exhibited :—

A slide of many diatoms symetrically arranged. (Mr. Whitelegge.)

A partially finished Monocular microscope manufactured by the exhibitor. (Mr. Weisener.)

A series of slides of Foraminifera and diatoms obtained from Port Jackson, mounted by a gentleman in London. (Mr. Kyngdon.)

Mr. W. H. H. LANE presented to the Society a copy of "Hogg on the Microscope, and five slides to the Cabinet."

Dr. MORRIS claimed the priority in the use of oil of Cassia as a mounting medium, and questioned the statement in the Journal of the R.M.S. (London) for August, 1886, page 717.

8 NOVEMBER, 1886.

The following were exhibited :—

A fine gathering of the rare rotifer, *Asplanchna Elbesbornii*, and a large *Amoeba* from the Waterloo marshes, also a rich gathering of *Volvox*. (Mr. Whitelegge.)

13 DECEMBER, 1886.

Dr. WRIGHT in the Chair.

The following were exhibited :—

Several slides from Hinton (London) of those diatoms described by Dr. Royston Pigott in the "E. Mechanic," also a slide of *Streptococcus of vaccinia*, taken from a human vaccine pustule. (Dr. Wright.)

Slides of several Polyzoa from Queenscliff (Vic.) (Mr. Whitelegge.)

SECTION I.—SANITARY SCIENCE.

TUESDAY, 22nd JUNE, 1886.

A preliminary meeting of members of the Royal Society of New South Wales was held for the purpose of resuscitating the sanitary section.

There were present Sir ALFRED ROBERTS, Mr. GIPPS, C.E., Mr. J. B. HENSON, C.E., Mr. W. A. DIXON, F.C.S., F.I.C., Mr. R. HUNT, Mr. F. B. KYNGDON, Dr. MACLAURIN, Dr. QUAIFE, Dr. GOODE, Dr. WILKINSON, Dr. FAIRFAX ROSS, Dr. CARRUTHERS, and Mr. REUTER E. ROTH, M.R.C.S., England.

Sir ALFRED ROBERTS was voted to the chair.

The following gentlemen were elected to form a Committee :— Chairman : Sir ALFRED ROBERTS. Secretary : Dr. REUTER E. ROTH, M.R.C.S., England, Dr. ASHBURTON THOMPSON, Mr. W. A. DIXON, F.C.S., F.I.C., Mr. F. B. KYNGDON, Dr. FAIRFAX ROSS, Mr. J. B. HENSON, C.E., Dr. QUAIFE.

It was agreed that the scope of the section should be that of the proposed "Bill of Public Health," as introduced by the Hon. C. K. MACKELLAR, M.D., M.L.C., and that the day of meeting should be the second Tuesday in the month, at 8 p.m.

TUESDAY, 13th JULY, 1886.

ROBERT HUNT, ESQ., in the Chair.

The rules formed by the Committee were read and adopted.

Dr. F. H. QUAIFE presented to the library of the section a copy Prigdin Teale's "Dangers to Health."

TUESDAY, 10th AUGUST, 1886.

Sir ALFRED ROBERTS in the Chair.

The receipt was acknowledged of the works published by the Melbourne Health Society. Sir ALFRED ROBERTS presented a copy of a pamphlet on "The purification of the water supply of Antwerp," by Messrs. Anderson and Ogston.

Mr. TREVOR JONES, C.E., read an interesting paper on "The Ventilation of Sewers." The paper was illustrated by means of diagrams.

TUESDAY, 14th SEPTEMBER, 1886.

Mr. F. B. KYNGDON in the Chair.

Dr. REUTER E. ROTH, M.R.C.S., England, read a paper on 'The Rational Construction of Chairs and School Desks."

The paper was illustrated by means of diagrams and models.

TUESDAY, 19th OCTOBER, 1886.

Sir ALFRED ROBERTS in the Chair.

The receipt was acknowledged of the various sanitary acts and regulations of the following colonial governments, viz., Queensland, Tasmania, Western Australia, South Australia, and Victoria.

Dr. ASHBURTON THOMPSON read a paper on "Scavenage," also a paper entitled "Notes on the recent outbreak of Small-pox on the "*Oceanien.*"

Dr. F. H. QUAIFE read a paper, "Notes on the Sanitary Condition of some of the Eastern Suburbs of Sydney."

TUESDAY, 16th NOVEMBER, 1886.

Sir ALFRED ROBERTS in the Chair.

Mr. TREVOR JONES, C.E., read a paper on "Suburban Sanitation."

ALFRED ROBERTS, Chairman.

REUTER E. ROTH, M.R.C.S., England,
Hon. Secretary.

The Ventilation of Sewers and the Dwelling.

By J. Trevor Jones, City Engineer.

[*Read before the Sanitary Section of the Royal Society of N.S.W., 10 August, 1886.*]

It having been demonstrated by the medical faculty, and a generally accepted scientific truth, that the offensive exhalations arising from the contents of sewers, are detrimental to human health, if allowed to mix in any sensible proportion with the breathing air of the city or household; and moreover, that it acts as a vehicle for any morbific germs that may be mixed with the sewage from the dejecta of fever patients, it becomes the duty of the Engineer, as the constructor of sewers, to devise means whereby such exhalations may be discharged in situations where they will not enter into the composition of the breathing air of the city or dwelling.

The emanations referred to are a compound body, known under the generic name of "sewer gas"; its component parts being, as stated in Mr. Baldwin Latham's elaborate work on the subject, varying proportions of carbonic dioxide, nitrogen, carburetted hydrogen, sulphuretted hydrogen, ammoniacal compounds, vapour of water, and fœtid organic vapours.

Sewer gas is said to act perniciously on the health of persons breathing it, lowering their vital tone, and predisposing them to suffer from the attacks of such germs of fever, cholera, small-pox, typhoid, &c., as may be projected into the sewage, of which the gases arising from the sewage form a convenient vehicle for the dissemination thereof.

The buoyancy, or tendency to float upwards in atmospheric air, of this compound gas varies in the proportion that it is composed of the lighter or heavier of the above constituents, and in proportion to its excess of heat over the surrounding air, but ordinarily it is found a little lighter than air.

From this tendency to rise, it flows from the lower toward the higher parts of a sewer, along the crown in a direction contrary to that of the fluids, and will escape into the air by any vent in the crown of the sewer that may be left for it; this property is taken advantage of by the engineer, who provides a close channel or upcast shaft for it to escape into such space as it will do least harm, or where it cannot mix with the air of the streets or dwelling.

If not so intercepted, and directed into such spaces that it cannot be breathed, it will at times gain such expansive strength in the sewer that it will force itself through water-traps and other contrivances into the dwelling, to the detriment of the air therein and the health of the occupant.

The occasional introduction into or outbreak of fever, epidemics, &c., in a town or city, although they are grievous calamities, generally serve one good purpose in directing a lively attention to the existence of any filth, to the appliances for securing cleanliness in the city, and to the suppression of noxious practices in the environs of the dwelling.

Sydney Sewers.

The sewers, now forming the system in use in this city, were constructed at various periods, under different engineers, and consequently vary somewhat in design, but generally exhibit sound knowledge in the designer, and perform their functions very well, if we grant that these duties consist of discharging the refuse liquids and storm-water of the city into the harbour.

While this is their present condition, it should be stated, although it is generally well known to most residents of Sydney, that the Government Sewers Department is engaged in the construction of a capacious intercepting sewer, into which the whole drainage of the northern and western slopes of the city will, when that work is completed, be discharged and be thereby conveyed to and discharged into the ocean near Bondi.

It should be mentioned also that the eastern suburbs will be accommodated by the same sewer.

The southern slopes, along with the suburbs that lie between the city and Botany Bay, are also in course of being provided for by a main trunk sewer, running generally along the bed of Shea's Creek towards Botany, where it crosses Cook's River by an inverted syphon, and discharges upon Webb's grant, a section of land which it is proposed to convert into a sewage farm.

The designers of the older sewers seem to have had in view the conveyance of the storm-water that falls upon the whole surface as well as the sewage, and this has entailed a larger outlay to secure this object than is considered warrantable under more recent ideas, since it appears to modern engineers that the gutters and water-tables should do a portion of the work, and thereby obviate the inordinate cost of making a double provision for the same work.

The southern system is being constructed to receive the rain-water from roofs and yards only, storm-water from streets, &c., being excluded.

When both the works referred to are completed, Sydney may boast of a system of sewers that will compare favourably with any modern city as far trunk main sewers are concerned; but in order to secure the full sanitary benefit of such works, two things must be attained, viz., that the houses connected with the sewers, before any strict supervision was exercised by the city authorities, should be examined for defects in their house-drains and fittings; and, secondly, that the sewers themselves should be provided with the means of escape for the gases that are continually being given off from their contents.

Ventilation of Sewers.

It is proposed to deal with the question of the ventilation of the sewer first by giving a short description of a few of the most favoured methods adopted by sanitarians in the past and such as are in use at present.

The first that presents itself is the obelisk form of ventilator, of which that in Elizabeth-street, at its intersection with Bathurst-street, is an excellent example.

This obelisk is merely a kind of chimney-shaft, into which is connected a branch from each of several sewers whose highest terminal point is adjacent to it.

It was conceived that this form of shaft would afford relief to the pressure of gas in all sewers communicating with it, by allowing such gas to escape through it into the air at its summit after passing through several perforated trays of charcoal at its base, placed there to absorb the offensive properties of the gas in question.

This system was in favour among engineers for a long time, until systematic experiments were made as to its effect in relieving the sewers; which was found to be disappointing, as its effect in relieving the sewer of gas was found to be infinitesimal at any greater distance than about 300 feet.

If, therefore, 300 feet be the limit beyond which the uses of shafts as ventilators would be reduced to nil, it follows that this would be the greatest distance apart at which such shafts could be spaced for the efficient ventilation of a line of sewers; and as their cost each would probably amount to £300 at least, their mere cost, along with that of the land on which to build them, would render their use prohibitive.

If the cost were not an insuperable objection, then the appearance of rows of these columns along every street would be fatal to their adoption while any other mode was available.

A great improvement in their effectiveness was achieved when the plan was adopted of kindling a fire at their bases (inside), all the air for the sustenance of these fires being drawn from the sewers.

The fire, by creating a draft, greatly accelerated the motion of the sewer air, and, furthermore, any germs of disease that might accompany the air were effectually destroyed; but even these improvements did not secure its adoption, partly because of the great cost of fuel and attendance, and partly because of the danger of explosion should an excess of carburetted hydrogen or other inflammable gas gain access to the sewer, as a mixture of one tenth by volume of this gas with nine-tenths of air is as explosive as gunpowder when fired.

An accident of this kind might affect miles of sewer, and prove very disastrous by throwing up streets or buildings.

Several accidents of this kind have happened in London and Paris, and even here one such case occurred in 1883, tearing up many chains of a newly constructed line along the Darling Harbour railway.

It is not necessary to adduce any more proof against the adoption of this kind of ventilator as there is little fear of its being selected by the authorities of this city, excepting in very special cases.

One such case would be an instance, where a large trunk sewer received a number of small branches, inasmuch as a large sewer, when not running, rapidly generates much gas; and it would be judicious, if space is obtainable, to erect one such shaft here to obviate the charging of the branches with gas formed in the larger sewer.

Midstreet Grating Ventilators.

When the above objections to tall-shaft ventilation threw it out of competition, two things became manifest, viz.: that in order that the sewer air might not at any time assume sufficient expansive power to force itself through intercepting contrivances into the dwelling, appropriate openings should be provided, and that those openings must be frequent along the course of the sewer.

To meet these requirements in a practical way, that is to say, that should at once be effectual without being inordinately costly, the plan was adopted of making openings in the crown of the sewer, and building a pit or shaft from the crown of the sewer up to the street surface.

By this method a series of pits covered with gratings were constructed along each line of sewer, at intervals of from 100 to 300 feet apart, explaining that if these were at sufficiently frequent intervals, the sewer air would be so dilute that it would not be observable.

To remove another objection, viz., that dilute as it might be, it might contain poisonous germs, the sewer air was made to filter itself through charcoal filters, for which it is claimed by some of

the most notable authorities that it is an effectual oxidizer of mephitic gases, and that therefore the air arising out of these gratings would be rendered wholesome and innocuous.

Hereafter I am about to contend against the use of these contrivances, for reasons that I shall advance ; but before doing so, I beg to express my utter diffidence in contending against the dicta of authorities for whom I have nothing but respect and admiration. Their works as well as the stupendous labour and thought they have bestowed on the investigation of this most difficult subject, command my entire esteem. I may add, that it is to these authorities that I am indebted for most of the improvements I have introduced into the Sydney system, with the exception of such peculiarities as local conditions have forced on me.

This mode of ventilation was specified for the main sewers of the southern system for this city by the late eminent engineer, Mr. W. Clarke, whose advice was sought in this behalf, and the sewers are now being constructed in conformity therewith by the Sewers Department.

The City of Adelaide sewers, designed and carried out by Mr. Oswald Brown, are fitted with these ventilators.

In writing a paper to the Government Board of Health, about four years ago, on this same subject, I ventured the opinion that this method would not be found suitable for Sydney sewers.

My objections were based upon the fact that, as a number of our capacious sewers discharge in a northerly direction, and that the prevailing winds blow from the north-east in summer, the sewers would receive the wind at their mouths when the tide was low, and this would exert a pressure internally tending to drive the sewer air outward through every orifice ; this, added to the fact that sewer gas forms rapidly in large volumes in this warm climate in summer, made me conclude that, no matter how frequent these gratings were spaced, there would always flow out of them an appreciable stream of fœtid sewer air.

Opinions are in conflict as to whether the charcoal filter would be a safe guard against the poisonous nature of these fumes.

At one time a large proportion of our street-gullies were untrapped or imperfectly trapped, and old Sydney residents need not be told what sickening exhalations rose out of the gratings.

If such orifices were at regular and frequent intervals, the exhalations would be more dilute, it is true ; but the fact of them being given off all through a still, warm night, would cause our not too wide streets with their high buildings to become charged with these mephitic emanations.

If merely making numerous openings would ensure that the gases would be so dilute as to be harmless, then an open-topped channel with a continuous grating would be still better; but I find it difficult to believe that this would be the result, remembering

that the slops and refuse liquids of the City of Melbourne are conveyed on the water-tables, and it is well known how objectionable this has proved.

When I was stating my objections to these gratings to the Board of Health, I was speaking from theory; but since the completion of the Adelaide system, I have been supplied with confirmation of my anticipation, as I received a letter from the City Council of Adelaide informing me that these gratings were found intolerable in certain localities, and inquiring of me what the practice was in Sydney, which seemed to visitors so effectual in suppressing smells from sewers.

I replied, furnishing directions as to the practice I am about to advocate herein, which I am informed is being introduced in that city, probably not on account of my letter, but because the engineers in charge of the sewers were perfectly familiar with the plan themselves.

Indeed, the gentleman who designed and carried out the work, Mr. Oswald Brown, was a man of European reputation, who found the scope for his energies in the Colonies too circumscribed and returned to Europe, when he had completed his work in Adelaide.

As I previously stated, opinions as to the efficacy of charcoal, and the durability of its efficacy are somewhat conflicting; but the cost of applying it, and in maintaining it in a state of efficiency, is not a matter of doubt, and is very heavy.

Having stated my objection to certain methods of ventilating sewers, it remains for me to explain the plan I would adopt by preference.

With reference to the principle that frequent outlets into the outer air are desirable there can be no dispute, but my contention is that these openings should not discharge the sewer-air at the street surface, under our noses, so to say, but at such elevation above our breathing spaces that it cannot again be breathed at all, but be dissipated in the surrounding air.

The plan recommended is neither original nor new, but in my opinion the best of recent methods, and is simply this :—

The house drain after being connected with the sewer is laid at the requisite grade to a point near the house; here is interposed a trap known as an interceptor trap.

The sewer gas will flow up this branch until it arrives at the trap; in order to get through this trap into the premises, it would have to displace about 2 inches of water, and the gas would be very much compressed indeed to effect this, but it is known sometimes to do so, if no easier mode of escape is provided.

The above trap, however, as well as having a water trap, is fitted with an outlet pipe for the gases from a small chamber on the sewer side of the intercepting tongue, which pipe is fixed to

the wall and conducted upwards to the eaves; or should any window or opening be too near the eaves, it is conducted to the ridge and their raised a few feet higher.

Discharged at this altitude it will be so dispersed, dried, and oxidized by the surrounding air as to be rendered harmless.

Many of the more enlightened architects of Sydney carry out this plan now for some of the leading buildings without pressure; but the Sydney Improvement Act contains no power to enforce the adoption of the system, and before the practice can be made universal, an amended Act will be required conferring such power on the Council.

It will not necessarily be requisite to erect such a pipe to every house, in order that the pressure in the sewer should be relieved, as some buildings are too low to secure proper ventilation; but if a pipe-shaft (say) of 5 or 6 inches diameter, be affixed to most of the loftier buildings, a sufficient vent would be secured.

A building now being erected by Mr. Alex. Dean for Dr. M'Laurin in Bligh-street, is an excellent example of the way in which these principles are to be applied.

Many other premises are similarly fitted, and these, as well as securing safety for their occupiers, help to relieve the sewers from undue pressure of gas.

The interceptor trap is on the same principle as that known as Buchan's, a sanitary plumber of Glasgow, and is a thoroughly well-considered device, combining adaptability to its functions with ease of access for repairs.

The New Zealand Insurance Offices in Pitt-street and several other buildings are ventilated by a different method, which dispenses with traps, trusting to the constancy of the upcast draught in the ventilating shaft exhausting the air in the pan and chamber. This method is adopted by Mr. Woodford, plumber, of Charlotte-street, and with success in every instance that I have examined. So long as the upcast draft can be maintained, there is no doubt that the efficiency of the contrivance will be sustained. The current is induced by a cowl on the principle of the injector pump. Cowl ventilators, however, only act when a breeze is stirring. In calm weather they must be inoperative, but, as in Sydney absolutely still weather is very rare, the above ventilator is generally effectual.

In a case where, from the arrangement of the premises, it is impracticable to obtain drainage at the rear, and when therefore it is necessary to lay the soil-drain under the floor of the dwelling to convey the sewage to a sewer in front, it will be seen by the lithograph herewith how desirable and even how indispensable it is to intercept the poisonous gases—in a manner that they shall not enter in at all; but the mere intercepting of it by a water-trap might not always prove effectual, as mentioned herebefore. Sewer

gas sometimes attains such power as to burst through the water seal, therefore most modern traps are fitted with a junction for a ventilating pipe, which offers an easier outlet for the gas than that by the seal.

A great deal of trouble should be taken in laying a pipe under a house floor upon sound foundation in such a manner that the ground will not sink under it, as any settlement in the pipes would crack or displace the joint, and thereby release both sewage and sewer gas under the floor.

Flaptraps have been largely used to prevent the reflux of gas and storm-water up the house drain, but this contrivance has proved useless after a little use, dirt, paper, sticks, straw, bottles, &c., getting between the lid and the trap.

This form of trap depends upon the closeness of its lid for its effectiveness. It has therefore given way in point of adaptiveness to the water-trap, which has completely superseded it. Its tendency to become immovable from rust or to wear at the hinges renders it unsuitable. Indeed, any movable piece or part in sewer apparatus has this objection, as sewage has a strong corrosive effect, and is largely charged with gritty substances.

With respect to that part of the subject termed the "ventilation of the dwellings," I have to explain that it has reference only to obviating their becoming charged with sewer gas, and not in its broadest sense of procuring a free exchange of fresh for vitiated air in the chamber, as the title would imply, as that question is more than sufficient for a paper in itself.

There is another feature in connection herewith, viz., the maintenance of the seal in the traps against the tendency of flushes of water in the soil-pipe syphoning the water seal out of the trap; but as this is a detail, it is unnecessary to load this paper with the consideration of it.

I shall therefore conclude by summarizing the objects of this paper, and the methods of so doing :—

(1.) That the Sydney sewers, for want of legislative enactment, being only partly relieved from the pressure of sewer gas emanating from their contents, it is desirable that legislative power should be obtained enabling the City Council to insist on affixing upcast ventilating pipes to the walls of any houses, where it may be found advantageous so to do, for the purpose of conducting the sewer air to the summit of such houses, and there to discharge it in such a position that it will not again mix with the breathing-air of the citizens. This pipe would not be more unsightly if in front of a house than the rain-water pipes.

(2.) That, owing to the defective manner in which connecting pipes from the city sewers into the dwellings have in

some cases been laid some years ago, whereby the air of the sewer is mixed with that of the dwelling, to the detriment of the latter for respiratory purposes, it is desirable that the City Council should by its officers be empowered to enter and examine such connexions, along with all sanitary fittings, with a view to rectifying any want of efficiency that may be discovered.

Clause 2 herein has, I am aware, about it a somewhat inquisitorial quality, and upon that ground will no doubt meet with opposition.

In mitigation, however, of its apparent rigor I would urge that the citizens of London and many cities of Europe have submitted to several such visitations by the Health Commissioners, and, although seemingly harsh, it will in the end be found to be beneficent in the interest of both private and public health, and will, I think, commend itself to the consideration of sanitarians generally.

It is not a little anomalous that some of our best and most pretentious dwellings are the least sanitary with regard to the air of their chambers, and the reason is not far to seek, as it will readily be understood that the best houses have their W.C. offices inside the house; and furthermore, they were, in a general sense, the first to avail themselves of the use of the sewer; therefore, as in the early days of making connections with the sewer, the supervision was lax, if not absent altogether, the work has been defectively executed in the first place, and, as examination has shown, the defects have become exaggerated by time.

The examinations of such connections and fittings is therefore a very important desideratum in the promotion of health in the dwellings.

The Sanitary Assurance Association, England, seeing that an official inspection would be expensive to a community as well as odious to householders, proposed an alternative, that the authorities should require a certificate from a competent sanitary authority, that every house has been examined and found to possess sanitary requirements such as to meet the demands of the local laws.

Whatever form the examination takes, and I would gladly support that which combines efficiency with freedom from annoying act, it must be clearly seen that some such examination will, one day or other, be brought about by public sentiment.

The subject, I fear, has been a tedious one, but I am glad that the Royal Society has laid the basis of a sanitary combination, as although the sanitary system of Sydney is a fairly efficient one, the early movements in this direction were partly tentative and defective, and such a combination as the present will go along with other efforts in the same direction to bring this noble city into an enviable condition as to its sanitary arrangements, as its natural formation so well lends itself to.

On the Rational Construction of Chairs and Desks.

By Reuter E. Roth, M.R.C.S., England.

[*Read before the Sanitary Section of the Royal Society of N.S.W., 14 September, 1886.*]

The following is a *résumé* of the paper:—"Dr. Roth pointed out that the spine consisted of a jointed column made up of individual bones which we called vertebræ. In early life this column was perfectly straight, but later on it assumed four curves, which increased in elasticity and strength. These curves were named from above down, cervical, dorsal, lumbar and sacral, the first and third being convex forward and the second and fourth back. On the curves of the spine, especially the dorsal one, would depend the healthy shape of the chest cavity. The more the dorsal region was bent the more were the ribs depressed, the capacity of the chest cavity diminished and its contents suffered. If the lumbar curve lost its concavity, all the abdominal organs became compressed and their healthy working was hindered, and as long as the normal lumbar curve was maintained it was impossible to stoop or be round-shouldered. The back, in sitting, required a support, and this support should fit the curves of the back, or what was better, in order to allow of more freedom of movement, it required a convexity to receive the lumbar and a concavity to receive the dorsal curve. In ordinary chairs this was never the case, the lower rail (when present) being concave instead of convex, and when absent the lumbar curve lost its concavity and filled up the vacancy in the chair-back. Such chairs caused a stoop in the back, round shoulders, and more or less compression of the thoracic and abdominal organs. The inclination of the chair-back should also be considered, because if the line of the centre of gravity of the sitting body fell in front of the axis of the hip joint the body would only be prevented from falling forward by the action of the hamstring muscles. These muscles became soon fatigued and were relieved in various ways, *e.g.* crossing the legs. It could thus be seen that children soon became tired at lessons when seated on a stool or form without a back. There seemed also no reason why music-stools should possess no back. As the player was without such a back-support he was compelled to support the body's weight with the hands, and consequently could not be expected to acquire a delicate touch. The height of the seat should equal the distance from the bend of

the knee to the sole of the foot; if greater, the legs dangled and the hard edge of the chair compressed the nerves and vessels under the thigh, giving rise to numbness and "pins and needles.' This also caused children to be restless and fidgetty after having sat for a short period. If the height of the seat were not sufficient, the knees became very bent and the legs could not be moved without moving the whole body. The depth of the seat should correspond with the distance from the backbone to within an inch or so of the bend of the knee, because, here again, if there were too great a depth the edge of the chair would cut into the calf, compressing the muscles and vessels. It was necessary for the surface of the chair to be horizontal. If it sloped at an angle, as was very often the case with easy chairs, although the back and shoulders were well supported, yet the thigh became bent on the body, putting the hamstring muscles inconveniently on the stretch, besides there being a liability to compress the sciatic nerves. In writing, the edge of the desk or table should overlap the edge of the chair, and be within an inch or so of the person's body, otherwise the healthy sitting position would be lost. The table might be too low or too high. In the former case the writer had to stoop excessively, and the arms, besides their use in writing, had to support the weight of the body. In the latter case the writer hung more or less on the edge of the table by his arms, or he might even twist his body round and remain suspended by the right arm. It was this injurious position which was the common cause of lateral curvature, with the right shoulder growing out and higher than its fellow. As long as the makers of furniture went in for ornament only, so long would our unfortunate bodies have to suffer. Still, there was no reason why chair-backs should not always have a lower convex rail instead of a concave one. In most of the new tramcars the seats were properly constructed, being made on anatomical principles. That there was some importance to be attached to the construction of chairs and school desks would be readily seen when it was considered that as a rule a good fifth of our lives was spent in a sitting position. Those whose occupations necessitated their sitting for many hours continuously, such as clerks, dressmakers, and others, stooped and had contracted chests with unhealthy organs, though fortunately for them these defects might be counteracted by physical exercise.

Dr. Roth showed various specimens of chairs and desks, made in accordance with his views of the form such articles should take, which were tested and commented upon by those present, and at the conclusion a vote of thanks was accorded to the doctor for his paper."

Notes on the Sanitary Condition of the Eastern Suburbs, etc.

By F. H. Quaife, M.D. (Univ. Glas.)

[*Read before the Sanitary Section of the Royal Society of N.S.W., 19 October, 1886.*]

As I make my ordinary rounds I am frequently met by the remark, what drainage you have about here! I apologise and point to the great works we are now carrying out which are to remedy all our ills, a great water supply, a magnificent sewer to carry away all our smells, all our typhoid, etc., into the Pacific Ocean, to be carried away to leagues of polar seas or eaten up, as I hope, by millions of animalcules and larger creatures. But the fact I cannot deny, my sight and smell both inform me, and I wish to put before you to-night a few examples more shocking than the rest, not because you are not familiar with them already but because reminder is good and because I think the present a time suitable to urge the efficient preparation for better things.

Even in the higher parts of our suburbs we are met by gutters full of dark ill-smelling water, and, especially where the fall is not good, it lies and decomposes and finally dries combined with what should be street sweepings, to be blown by the winds into the open windows of the houses or even into water tanks, which are numerous. It also annoys the passenger as he passes along. But when we pass certain low lying open drains we are assailed by a more concentrated and therefore more horrible stench, especially on still nights, often sultry, when the houses are all opened to obtain what cool air may be possible to get, and then we are forced to steer along the middle of the street to avoid the odours of the gutter on either side. A notable example of this will be found in the lower part of Moncur-street, Woollahra, and a portion of Point Piper Road, at the head of Glenmore, also in another portion of the same road on the steep slope towards Double Bay. The municipal authorities have exhausted their wits in trying temporary measures. But the deodorants are fleeting and the decomposing matters seem eternal.

If you go along the low part of Glenmore Road across the valley near the bridge you will find a sluggish stream winding round some land supposed to be a recreation ground and meandering through the Chinamen's gardens below the road on its way

to the bay, whose exhalations are painfully apparent to the least sensitive nose. In heavy rains I have seen a cataract leaping down into that glen from a cliff, but it did not sparkle like those of the mountain, but was of a muddy brown colour and consisted of the rain carrying down all the washings of the small streets in Upper Paddington. Higher up, the same stream, which for years has contaminated the air along Broughton's wall in Cascade street, is now being turned into a sewer which will for the present end at the before-mentioned cliff. Another filthy stream runs from Lacrozia Valley and joins those above mentioned and flows into the Rushcutters' Bay, through the Bridge on New South Head Road. Before the foreshore there was reclaimed the stench was awful, and I am sorry to see that a delta is now forming in the bay and that soon it will be nearly all filled up. The shallow tidal shore west of Darling Point used to reek with filth, and even now the reclamation does not go so far out as the tide recedes. Numerous cases of typhoid have occurred in the houses on Darling Point, along that side, and many in workmen engaged in constructing the sewer that now runs into the head of the bay. I might multiply examples without limit, but I must notice one or two more. Round the north-eastern border of the watershed, which at present mostly supplies Sydney, in Waverley, are slopes of sandy loam, once open paddocks, from which large quantities of water drain into the reserve. These are now rapidly being built over, right down to the fences of the reserve, and each one of these contributes its quota of kitchen wash slops, and perhaps worse, to contaminate the water supply. Filtration dams, no doubt, in conjunction with the absorbing properties of the sand, at present prevent much harm arising, but the time is rapidly coming when the sand will be saturated, and the filthy matters pass lower down. An epidemic of typhoid in that locality would even now very likely cause germs to pass into the lower dams, and so into the water supply of the city. Higher up there is only a thin layer of earth or sand over rocks, and after rain you will see water oozing out all over at the edges of the rocks, so that much drainage must come from everywhere on the western side of the ridges.

In some of the gutters the stench is so peculiar that one cannot help thinking that fæcal matters have overflowed, or otherwise got into them. No doubt deficient water supply aggravates the evil; but though more water would help to purify those in the upper parts it would only carry the offensive matters to our neighbours lower down.

Occasionally worse things happen. During a very heavy flooding rain some time ago I was going along a lane on the Underwood's estate, Paddington. This lane was so full of water, running west, that I had to pick my way along the edges, and I noticed a

horrible stench all along, though one would have thought there was plenty of water to carry everything foul away. The explanation was that the rain had overflowed the tops of some cesspits in yards at a rather lower level, and syphoned them out; but the houses to which they belonged being still lower, and, as is too often the case, the back doorstep being very low, the diluted filth ran down the yards and through the lower floors of the houses to the consternation and disgust of the dwellers. I had a very bad case of typhoid opposite the very spot in that lane, and I remember that she had a very bad relapse just after. Can it be wondered at that low-lying places are unhealthy when such things occur, and that milk coming from dairies in such low-lying places should be unfit for use.

Owing to the way in which the land has been subdivided, and thickly crowded with dwellings, mostly of the terrace order, with, in many cases, small back yards with not a yard of garden soil available, the only possible method of getting rid of the liquid slops of the dwellings has been to discharge them into the nearest gutter. Some of the boroughs have, I know, by-laws prohibiting this practice, but they are necessarily nearly everywhere a dead letter. Matters specially faecal are being dealt with either by the old cesspit system or by earth-closets. The evils of the former I need not dwell on, but the latter, which promised well, are in practice very difficult to manage, and, in the hands of careless people, and in small tenements with large families, are nearly as great a nuisance as the cesspits. Indeed the great difficulty in the system is the getting rid of the liquids. Where there is a decent bit of garden ground or a spare bit of land there ought to be no difficulty in working this system. In Waverley the Council works it, but I am informed that it is really worked like the Melbourne pail system, and is a great nuisance; in fact efforts are now being earnestly made to improve it. For those suburbs at a considerable distance from the city no doubt some such system must be used for a long time, but in those nearer and within reach of it we are promised soon the introduction of the water-carriage system by means of properly constructed sewers. I trust that this will be so, and it is therefore that I wish to impress on the section, and if possible, through it on the authorities and the public that immediate steps should be taken to insure the introduction of this system in the most perfect way possible. It is a very large question and should be dealt with in a broad way. It should not, I think, be left to each borough to introduce it for itself, but a general plan for all the suburbs coming into the scheme should be adopted. For the drainage should to a large extent follow natural slopes for economical reasons alone, and as the boundaries of boroughs are nearly entirely determined by artificial causes it would be almost impossible for any one borough to ensure that its scheme

would fall in with those of the adjoining ones in the best possible way. Further, each body would have to employ its own engineer, and that would entail greater expense, and possibly conflicting views. I therefore think that the great matters of water supply and sewerage should be managed for the whole metropolitan area (within certain limits) by a representative Board, with members elected upon it by all the municipalities concerned, certain members appointed by the Government, and among them several scientific persons, such as an engineer, a sanitary medical officer, and a scientific chemist. This Board should have power to levy taxes, to inspect premises, to carry out work itself, or see that the proper persons did it, and all those powers should be compulsory. I find that by the Act, 43 Victoria, No. 32, such a Board is authorized to be created, and that its powers at present are vested in the heads of the Harbours and Rivers Departments for water and sewerage respectively. But I think that seeing that within a year the large portion of the great eastern sewer will be available from the sea to the boundary of the city, it is time that some steps were taken to bring this important matter to a practical issue.

We have in these suburbs practically a virgin soil to work on, and I do think that it will be a great calamity if the system is introduced in such an imperfect manner as to become a curse and not a blessing. The ignorance of sanitary matters among builders and workmen is so great that I feel that we are in great danger of such a result coming about, as even in the city itself I think our eminent city engineer will admit that he has difficulty in getting work of this kind carried out with all the necessary care.

I was astonished some time back to hear him say that he could only recommend that defects already existing should be altered; and I wonder that the power has not been obtained by the City Council to compel new sanitary arrangements to be carried out in such cases. Only lately, in one of the finest houses in the city, occupied by two medical men, one of whom was a sufferer, there were several cases of typhoid, and it was found that old untrapped and unventilated drains were the cause.

The Board should take cognisance of the whole sewerage plan of every dwelling from the main street sewer to the water-closet, and should see that all traps and ventilators or other apparatus used are of the latest and most scientific kind. I do not feel sure from a short perusal of the Act that power is given by it as is necessary to ensure such being the case.

I trust, gentlemen, that these imperfect remarks may have some effect in hastening our deliverance from the perils and nuisances sketched out, and in bringing about a system of drainage which will be most efficient in warding off disease, and preventing the pollution of our streets and premises.

The recent outbreak of Small-pox on the M.M. S.S. "Océanien."

By J. Ashburton Thompson, M.D. (Brux.), San. Sci. Cert. (Camb.)

[*Read before the Sanitary Section of the Royal Society of N.S.W., 19 October, 1886.*]

The subject of quarantine, although of great practical importance, is not, perhaps, of very general interest; and I feel that some few words of explanation are necessary before I venture to occupy your time with the brief account of the recent case of the "Océanien," which I propose to submit to you presently. I need not now insist upon the necessity which renders it indispenable to regard the whole of Australia—it may even be said, the whole of Australasia—as one country for this purpose of quarantine, since it is thoroughly understood and accepted. If, however, the interest of all the colonies in this matter are the same, it follows that their practice with regard to it should be identical; and this view, also, is understood and accepted by the various health officers. Moreover, the desire that identical lines of practice should be followed, which is so earnestly felt here, is entertained everywhere else, but nowhere, perhaps, more earnestly than in Victoria. Yet it cannot have escaped your attention that the course pursued here in the case I refer to was essentially different to that which had been pursued under the very same circumstances, and only a day or two previously, at Melbourne. At that port the vessel was regarded as clean, and she was admitted to free pratique; here, she was regarded as infected, and she was detained in quarantine for some days. I do not think that so marked a difference of practice, and one so puzzling to shipowners and the general public, should pass without comment; and I believe the facts of the case may profitably occupy your attention for a few minutes.

The "Océanien," after an uneventful voyage of the usual duration from Marseilles, touched at Aden, and on August 8th left that port. On August 9th a passenger and an officer, and on the 10th the chief cook, were discovered to be suffering from modified small-pox. The passenger was shut up by himself in an ordinary first-class cabin; the officer was shut up in his own cabin, which is on the same deck amidships; and the cook was placed in an

apartment called the hospital, which is on the same deck too, but away forward, between the third-class quarters and the forecastle. No doubt, such arrangements were made for confining the infection to the quarters named as seemed practicable. The port of Réunion (which, it will be remembered, is a French Colony), was reached on August 16th, and the Chef du Service de Santé was requested by the captain to remove the three patients, and to disinfect and cleanse the vessel. He refused, however, to receive any but the sick passenger, who happened to be bound for that place, and who, I presume, could not be refused; and he did not cleanse the ship. Mauritius, the next port, and in an English Crown Colony, was reached on the 21st; and there again the captain requested the Health Officer to certify that the ship was free from infection. This application was not made until the eve of departure, that is to say, not until the 26th, when the captain says the patients had recovered; nevertheless, the Health Officer replied that he could not certify to facts which had not come within his own observation, and, in short, declined to board the ship, or to have anything to do with her. So the voyage was pursued, the two remaining patients returning to duty on the 28th; when the quarters they had occupied were fumigated and cleansed, and all their personal effects thrown overboard. Adelaide, for which port there were no passengers, was reached on September 10th. Some cargo was discharged in quarantine, and the voyage was continued after the captain had been warned to bring-to on entering Hobson's Bay. On September 12th Port Phillip was touched, and the vessel was boarded by the Boarding Medical Officer and by a medical member of the Central Board of Health. After due examination, these officers gave the vessel free pratique; thirteen passengers, luggage, and cargo were discharged; and the day being Sunday, about 200 visitors went on board during the afternoon. On resuming the voyage, the captain was granted a clean bill of health without any endorsement; and on September 15th the vessel touched Port Jackson, at 6 a m. On entering the Heads, the captain was ordered to hoist the yellow flag, and to anchor in quarantine waters; and at 6·30 she was boarded by the Health Officer and myself. Careful examination failing to detect any present case of small-pox, at 7·30 she was handed over to two of the quarantine officers, and the usual fumigation and cleansing was at once begun by the Superintendent of Quarantine. First, however, all passengers, with their servants and stewards, were lodged on shore, and as many of the crew as could be spared were landed at the laundry, where they washed and disinfected clothing and luggage. By the afternoon of the following day all these operations had been done under the eye of the Superintendent, and to his satisfaction; his report was received, and on the third day was considered and approved by the Board of Health. The

Health Officer was then in a position to order the release of the vessel; and in this course the Board of Health would have concurred, but during the previous night a case of febrile disorder had occurred in the person of the ship's butcher. The illness was not especially suspicious; indeed, there was very strong reason from the first to expect that it would turn out to be of no consequence. But under the circumstances it was deemed prudent to defer discharging the vessel for four-and-twenty hours; and she was released at last on the fourth day after her arrival, at 1 p.m. These are the undisputed facts of the case. Two questions arise in them—First, why was the vessel treated as infected at this port, when she was treated as clean in Victoria? And secondly, if she were infected, why were her passengers not detained during the usual incubation period?

The first consideration is, that the infection of variola clings to inanimate objects with great tenacity; so that a ship which has carried a case of small-pox during the voyage must of necessity be regarded as being infected with that disease down to the time at which she is officially declared to have been thoroughly cleansed. This is the view taken—but no one disputes it—by the Sanitary Conference; and it is expressed in their fourth resolution.* Upon this account alone the "Océanien" would have been treated here as infected. But, it may be objected, there is no evidence that the vessel in general ever was exposed to such infection, because the patients were isolated in certain cabins, which there is no reason to doubt were thoroughly cleansed after their recovery. To this criticism there are several answers. If it be granted that the case really was as it represents it to have been, yet the cleansing was done by the captain of the ship. No health authority is justified in relying, for the safety of the people whom he is charged to defend from imported infection, upon the statements of persons over whom he has no control. Thus stated, the proposition appears self-evident; but it may be added without offence to captains in general, and merely as testing the legal value of the evidence they can give upon this point, that they are interested parties—interested, that is to say, in procuring the speedy discharge of their vessels rather than in protecting the people of an alien country from disease. The same objection does not apply to any evidence they might be able to produce, under the hand of an independent health authority of whatever country, that careful, thorough disinfection had been done. No doubt, a vessel which, having carried cases of small-pox during the voyage, could produce a certificate stating that she had been inspected by the Health Officer of some port, that she then had no case of disease on board, and that she

* "A vessel infected with small-pox is one which has carried a case of that disease during the voyage."

had been disinfected by his own staff under his own supervision, would on arrival here be detained no longer than necessary to ascertain that no further case had occurred subsequent to that inspection. But, is it the case that the ship as a whole had never been exposed to infection, but that the latter had been confined to the quarters occupied by the patients? I pass over details, such as the difficulty of attending to patients isolated under such circumstances without exposing their servants to risk of infection, and I proceed to consider the possibility of effectual isolation on board ship. This the Conference specifically denied; but it happens that the untrustworthiness of the measures taken to secure it in this case has already been demonstrated. I have said that the cook was isolated in the hospital. Now, just a year ago a case of small-pox occurred on board the "Océanien"; and the patient, a boy named Manoni, was "isolated" in the very quarters occupied on the present occasion by the chief cook. That patient, also, fell sick the day after the vessel left Aden, and at the ports subsequently touched nearly the same treatment was given her as on the present voyage. At all of them she was treated as infected until Australia was reached; all of them refused to allow communication. But she no sooner touched Adelaide than she was declared clean; she received free pratique at Melbourne; and in consequence she escaped inspection at this port. You will remember what followed; she had only been in this port a few days when a case of small-pox among the sailors was reported; and upon examination of the crew, I found two other persons actually with a half-healed eruption of small-pox upon them. It was thus proved on that occasion that the isolation of Manoni was not such as to prevent the spread of disease among the crew. The deliberate opinion of the Conference, which was based upon many similar cases known to the several delegates, and which had been given long before, was thus supported; but it was thus shown that the cook's isolation during the present voyage was actually untrustworthy, since exactly the same isolation in Manoni's case had signally failed. Infection, then, could have spread from the cook's quarters to the rest of the vessel; the whole ship, therefore, had to be considered infected; and down to the date of her arrival here she had not been cleansed to the satisfaction of any independent health authority. It still remains to answer the second question—Why, if the vessel were infected, were the passengers not detained for the usual incubation period, and the ship despatched in quarantine? The answer is clear. Quarantine is always a hardship; it impedes traffic, deprives many persons of liberty, and causes considerable expense to all parties concerned. Its justification is a reasonable probability that it will save the importing country from epidemic disease. In considering what should be done with this vessel, therefore, all the circumstances

of the case were taken into careful consideration. Thirteen passengers were known to have landed in Melbourne ; 200 citizens had visited the infected ship, and dispersed to their homes ; any of these might have actually been in Sydney before the "Océanien" came into port. Under any circumstances, little of value can be done by inland quarantine; under these circumstances especially, nothing could be done. It appeared, therefore, that the usual detention, if it were enforced here, would be vexatious—its hardships would be incommensurate with any advantage which could be hoped from it with confidence. The detention therefore was not insisted upon. But, had this been the vessel's first port of call in Australia, it would certainly have been enforced for the reasons already given.

I am constrained to add, that there seems to have been a dereliction of duty along the whole line. The Health Service at Réunion acted with sheer cruelty in condemning some 300 people to remain shut up with two cases of small-pox on board the ship. It was clearly a duty owing first to humanity, secondly to their countrymen, and thirdly to a mail-service subsidized by their own Government, to have taken all three patients into quarantine, and to have thoroughly cleansed the vessel. Had this course been followed, she would, upon the production of sufficiently detailed certificates of cleansing under official seal, have been regarded here as having begun her period of observation at the time of leaving Réunion ; and this would have elapsed by the time she arrived at Adelaide. The matter seems to demand the attention of the French Colonial Office, and I am informed that its intervention will be sought by the Company affected. Almost the same remarks apply to the Health Office of Mauritius ; but their case is aggravated by there having been at the date they were appealed to no question of receiving actually sick persons, but merely of fumigation and cleansing. This, too, was a duty owing to humanity. It appears to me that in this case the intervention of our own Colonial Office might well be sought ; and, as Mauritius is a Crown Colony, no doubt its remonstrances would take the form of commands. The officers at both of these ports seem to have been actuated by no other motive than to shirk the responsibility which it was their fate to encounter face to face ; and they did shirk it. Upon South Australia fell the duty of disinfecting the ship, no less than upon the two former Colonies ; and, Adelaide having failed, even as they did, it devolved upon Victoria. As to the latter, I simply cannot understand the action taken there, and I therefore pass it over without further remark. At last the "Océanien" reached our shores ; and here all was done that events and lapse of time had left possible.

A Note upon Scavenage.

By J. Ashburton Thompson, M.D. (Brux.), San. Sci. Cert. (Camb.)

[*Read before the Sanitary Section of the Royal Society of N.S.W., 19 October, 1886.*]

The removal of dirt from a single dwelling is called cleansing. Scavenage is the cleansing of aggregated dwellings by public authority. It can be properly done only by co-operation of all the inhabitants, and the method to be adopted falls for consideration, therefore, especially within the province of the aldermen—that is, within the province of those members of the community who are chosen from the whole number to direct the forces which co-operation renders available into the most useful channels. These forces are means of securing all those benefits which distinguish town life from camp-life, of which the most important appear to be good water, roads, and scavenage. The two former being now tolerably well provided here, the time has come when the necessity for more thorough scavenage is recognized; and the occasion of my addressing you is the tendency which is plainly perceptible in public bodies to seek after cheap, as distinguished from economical, methods.

Scavenage, thoroughly done, is of necessity costly, even when it is, in the truest sense, economical. It never has paid its own way, and it never can do so. That science should be able to show how something valuable may be reclaimed from matters which, to the individual, are mere *exuviae*, is a hope long since realised; but to expect that waste, accumulated under the artificial conditions of city life should support that life in any sound commercial sense, appears to me thoroughly unreasonable. Those who flatter themselves they hold this view may find, on consideration, I believe, that it is based upon the general truth that matter is indestructible. At all events they entirely forget to take into account the expenses of collection and carriage, which are unavoidably such as would render articles of much greater acknowledged value not worth handling; and they forget that, although their market will fluctuate, they must yet continue uniformly to produce, and at an ever increasing rate. And in fact the nett outcome of experience thus far may be summed up in the following axiom: The community which regards the removal of its domestic refuse as a commercial transaction (in which, therefore, it will not embark considerable sums unless some immediate pecuniary profit can be seen) starts from false premisses, and strives to seize a chimera.

The true premiss is—not that society must make money out of its necessities, but—that society must preserve health and useful activity under the artificial conditions it has itself created, as long as may be. So it comes about that, while removal of refuse matters and expense are both conditions of good scavenage, the actual cost is but secondary to the urgent necessity for doing it.

Nevertheless, whatever expense, within reason, might be incurred to secure good scavenage, ultimate profit could be shown to accrue. For dirty districts are unhealthy, and disease costs money; but to cleanse districts is to reduce disease, and therefore to save money. The profit is incalculable; not, however, because it is infinitesimal, but for an exactly contrary reason—that it is reverbatory or regenerative. The householder, in estimating the expenses of city life, should set down a rate for scavenage as much as a matter of course as he sets down the rate for water, or for gas, or house-rent itself. Yet, just because the profit arising from public cleanliness is not calculable at so many sovereigns per cent. upon so many sovereigns invested, but even more, perhaps, because it does not visibly flow into individual pockets, it may be too much to expect that the average householder should be eager to pay a scavenage rate which does obviously diminish his individual banking account. His judgment of the necessity for such work, and therefore of the amount it is worth his while to pay for having it done, is likely to be fallacious, in so far as it is formed upon the events of daily life as they appear in the obscure and confusing light thrown by half-forgotten memories of inaccurate observations. Experience has shown that even so indisputable a necessary as pure water cannot be made to appear so desirable to all the members of a community that all willingly pay their share of the expense of bringing it to their doors. It is everywhere found necessary to enact that whenever water is led within a certain short distance of a house the owner shall pay his share of the general expense whether he chooses to take the water or not. How much more likely is the same experience to follow the introduction of systematic scavenage; and how important is it, therefore, that town councils should everywhere be granted **power to strike a scavenage rate!***

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* This they do not at present possess in New South Wales. They can levy a sewerage rate under the Municipalities Act, but this cannot be interpreted to include scavenage. And under the Nuisances Prevention Act they can recover from householders any expense incurred in removing night-soil from premises. But the 26th section, which defines the nuisances in respect of which proceeding might be taken, cannot, I believe, be interpreted to apply to garbage; and the cost of removing this must at present be paid, like that for street cleansing, out of a general rate. And the limit of amount up to which a rate for general purposes may be levied is now far too small to bear the expense of scavenage as well as the other expenses it must have to meet.

Secondary to expense though good scavenage may be, the former is, notwithstanding, a condition which must be reckoned with. Scavenage half done is a mere covering up of offence—an impudent attempt to cheat nature; sheer waste of money therefore. Farther, scavenage is never so well done when it is let at contract as when it is undertaken by the community itself through its aldermen, provided the operations are subject, in case of necessity, to the control of a central authority. Bearing these two considerations in mind, and recalling the now well-known fact that the scavenage of cities has never yet been made to pay its way, much less, therefore, to yield a profit, the proposals of certain companies now before the public may well be regarded by ratepayers and aldermen with a coolly critical eye. They all offer profits to their shareholders, one of them venturing to promise so much as 50 per cent. Now I do not for an instant intend to dispute the power of these companies to make a profit, if their own terms of contract are accepted; but whence is it to come? From the manufacture of poudrette? Not entirely, at all events. There is not one of them but asks a subsidy in one form or another. Sometimes it appears as a heavy charge for deodorization; sometimes as a charge, not for collecting the material, whether that be nightsoil or garbage, but for receiving it at the company's works, after the labour of collection has been borne by the corporation; sometimes, again, as a heavy charge for collection and disposal. Hence some of the profits. But the chief expense of scavenage lies in the process of collection, not of disposal; collection being done gratis, disposal may doubtless be made a source of profit. Is there any chance that a company might seek to increase its margin of profit by reducing the expenses of collection to a point at which it would become impossible to do it well? In fine, when all things are considered, is it not pretty clear that councils would best consider ratepayers' interests, both of pockets and health, if they were to undertake this business of scavenage themselves?

Sanitation of the Suburbs of Sydney.

By J. Trevor Jones, C.E.

[*Read before the Sanitary Section of the Royal Society of N.S.W.*, 16 *November*, 1886.]

The question of the sanitation of the suburbs has at various times agitated the residents thereof, so far as to lead to the calling together of meetings, having for their object the initiation of steps to secure the benefit of some system whereby the refuse of modern housekeeping and fœcal products might be disposed of in some better way than is done at present.

The city of Sydney set early in its history about securing accommodation of this character by taking advantage of the steep declivity of the surface to discharge the combined product of house-refuse and storm-water into the harbour, and more recently has undertaken to intercept the bulk of it by a main trunk collector sewer, so designed as to discharge its contents into the open ocean; and is also actively carrying out a water-carriage system for the southern slopes to convey the sewage of those localities to the neighbourhood of Botany Bay, where it is proposed to establish a sewage farm for its utilization.

The adoption of a scheme for the suburbs has been retarded by many considerations, comprising, among others, the contentions of opinions as to which is the very best method of attaining the desired result most effectually with the least expenditure of labour and money, as well as with the least amount of annoyance.

The earth-closet, the pan-closet, the Lieurnur, and other systems, all putting forth their claims to the embarassment of non-technical communities, and all more or less contending against the popular water-carriage system on account of its wastefulness of a valuable fertilizer, and its property of generating and disseminating gases of a character deleterious to the health.

The systems advocated by disentients from the water-carriage system have each their respective claims on adoption, and their schemes are the outcome of the labours of thoughtful public-minded men, and their allegations as to the objections to the water-carriage system are based upon fact—that is to say, sewage flowing in sewers does give off deleterious gases, and which, if not excluded from the dwelling, renders the breathing-air unwholesome.

It is, however, unnecessary to enter into lengthy details as to these acknowledged objections to sewers, inasmuch as, in the opinion

of men who have had most experience in Europe and elsewhere, it is the only system at present known to meet all requirements of populous cities with the least objections; more especially, when it is considered that the above objections can be met by ventilation, and that no other system offers a means of disposing of kitchen-slops along with the fœcal refuse of a practical and unobjectional character.

From the above remarks it will be seen that this paper is to be devoted to the advocacy of the water-carriage system, which excludes the conveyance of storm-water from the sewers, and is known as the Separate System.

With reference to the popularity of a system of sewers, my experience in the city of Sydney is, that citizens are as importunate for sewer accommodation as they are for water, roads, bridges, &c., and never to my knowledge begrudge the rates.

Another impediment to the progress of sanitation in the suburbs, as well as to the adoption of systems of water-supply, is the inveterate habit of colonists in New South Wales of looking to the Government to initiate and endow them with systems, and, allied to this, is the assumption that a comprehensive scheme to meet all the requirements of the suburbs is at some future day about to be entered on by Government.

I must be allowed to deprecate the inveterate practice in New South Wales of waiting upon the Government in every emergency. Reliance upon Government for works of sewage and water-supply acts as a pernicious opiate on the self-reliance of a people.

Now, with respect to this latter consideration, while generally approving of comprehensive schemes for public works, it by no means follows that a compact community should not set about securing accommodation for itself, but which should be so designed as to form part and parcel of any general scheme that might thereafter be initiated, and that without entailing any greater cost.

Still another stumbling-block in the way of public sanitation is the assumption that it is a costly work (which it is), without giving its due consideration to the most important fact that, as well as providing for the convenient disposal of sewage in a cleanly and healthy manner, it is a reproductive work, and that it secures the desired accommodation of sewage disposal at an immense saving over the present pan system.

This paper, while advocating the water-carriage system, does not necessarily presuppose the wasting of a valuable fertilizer if it be found that a market can be got for it; but hitherto all attempts to utilize this material have only succeeded in reducing the outlay incurred in its treatment for market.

Sewage farms have been instituted for its utilization; but in England, where a large proportion of the days of the year are wet, the application of liquid sewage over-drenches the land, already

saturated with rain, and entails the pollution of streams by the inflow of unfiltered sewage into them during wet weather, when it cannot be all absorbed.

In Adelaide, however, a fairly successful sewage farm has been established, and, according to information received from the mayor of that city quite recently, is doing good work.

The number of dry days in Adelaide in the course of a year about equals those of Sydney, which encourages the hope that sewage might prove a blessing here, if a locality sufficiently removed from a populous neighbourhood can be secured for its application to the growing of crops, trees, and vegetables.

The consideration of this point will come later on in the course of this paper.

The system now obtaining such unqualified approval in Adelaide, is identical with that proposed herein, so far as the mode of conveyance is concerned. It is called the Separate System, because if underground drainage is desired for both storm water and sewage, they shall flow in separate channels; as thereby the sewage is obtained in a more concentrated form for treatment, and also, the conduits necessary for this system are of small dimensions and therefore obtainable at small cost.

It is designed in this paper to treat of the several points here adverted to in the following order :—

1. The suitability of the water-carriage system over others.
2. Outfalls.
3. The practicability of adopting a system for an isolated small community, independently of any proposed comprehensive scheme, and the possibility of adapting to any such general scheme all the works constructed.
4. The reproductive character of a sewage scheme.
5. Health statistics proving improvement to the health of a sewered district.
6. The ventilation of sewers.
7. Sewage farm.

1. **The suitability** of the water-carriage system over others.—Where a water supply is available, it ensues that the domestic slops and refuse greatly exceed in bulk those of localities where water is scarce ; hence the street gutters and channels are generally in a running condition, and therefore while their contents are more bulky, they are less offensive, the sewage being more dilute, and the gutters if properly constructed, are better flushed. Notwithstanding all this, such gutters are always giving off offensive odours, as may be witnessed in the Melbourne gutters.

Into these gutters only kitchen slops are allowed to be thrown, all fœcal matter being rigidly excluded.

These slops contain ingredients which pollute the air almost equally with fœcal refuse, and if allowed to run without filtration in the street gutters, present a most objectionably slovenly appearance as well as being offensive to the nostrils.

While therefore other schemes of sanitation are more or less effectual in providing for the disposal of the fœcal refuse of a dwelling, not one of them shows a practical way of dealing with ordinary slops.

The water-carriage system—that is, a system of brick and stoneware drains laid deeply underground—receives indifferently either and all such sewage, as well a proportion of the rainfall, affording to householders and manufacturers a ready and inoffensive means of getting rid of their waste fluids.

It is true, as hereinbefore stated, that deleterious gases are given off by sewage; but under the head of "Ventilation" this objection is rendered harmless.

For the above reasons, and the almost universal testimony of sanitarians, this paper assumes that the water-carriage system is the best.

It is scarcely necessary to enter into any minute description of a water-carriage system of sewers, it being fully known that it consists of underground conduits of brick, stone, concrete, earthenware, stoneware pipes, &c., laid with proper fall towards the outfall, laid also so that they may be accessible in the event of stoppage at frequent points for inspection and repairs, and having appliances and the usual accessories, much of the character of the recently-constructed sewers of Sydney.

The object of this paper is not to enter into the details of construction, even if the space permitted of it, but to show that a plan is available to any one or more of the Sydney suburbs, whereby they can have a system either jointly or severally which will dispose of their sewage in an effectual and inoffensive manner.

2. Outfalls.—Nearly the whole of our immediate suburbs drain either into the Harbour, Botany Bay, or into the Parramatta River or some branch thereof, and an Act of Parliament specifically forbids the discharging of fœcal matter into any of the above waters.

This limitation, therefore, practically prevents the adoption of the water-carriage system unless accompanied by the practice of rendering the effluent sewage free from fœcal matter, and the method contemplated by this paper includes the same treatment of sewage that obtains in the inland counties of England. The Rivers Pollution Commission permit of the treated sewage being admitted into the local rivers, wherefrom domestic water is drawn.

Instead of discharging the raw sewage direct into the river or inlet, it is made to flow into capacious underground tanks or reservoirs, wherein it is treated chemically, so that it deposits its solid constituents on the bottom, and the effluent is drawn off at

the lower end, clear in proportion to the treatment it has received and to the capacity of the tanks. The tanks are designed of sufficient capacity to allow of plenty of time for the sewage to precipitate the solids ; and at the inlet a liquid charged with some precipitating drug, as sulphate of iron, dribbles a proper proportion of the drug in such a way as to thoroughly charge the sewage ; this is allowed quietly to settle, and the supernatant liquid when properly treated runs off as clear water.

In a situation where the waste water flows into a branch of the Harbour waters the cost of drugs is much less than that entailed to render the effluent fit for entering a fresh-water river, as the purity need not be so high.

The tanks are required in duplicate or triplicate, in order that settlement may take place and the water be drawn off ; the sludge is then spread in the open, so as to solidify and become portable for transmission to farms or other destination, it having been deodorized by the first process.

3. At Hertford, England, Mr. E. O. Moriarty, Engineer-in-Chief of Harbours and Rivers, here witnessed the process, and during the proceedings saw the engineer-in-charge draw a glass of the effluent and drink it, such was his faith in the efficacy of the treatment.

To recapitulate, therefore, here we have a process of collecting automatically, purification by settlement or precipitation, associated with the utilization of the fertilizing constituents which has been at work successfully for about 16 years, and which can be applied for the uses of a small community without sacrificing its adaptability to become part of any general scheme thereafter.

Nevertheless, the question has its obverse side, and it must not too hastily be taken for granted that all this is accomplished without considerable expenditure in the first place, and the dedication of space where dwellings are sufficiently removed for obviating the experience by the residents of any taint in the air.

Can this last condition be secured for any of the suburbs of Sydney ?

The acquisition of suitable land for the above purpose will be difficult, but in view of the paramount importance of the question it should not be impossible, and when secured it should be the depot for as large an area as can practically drain into it, so as not to multiply such establishments.

In Sydney, we know from experience how the residents of a locality within a radius of miles will rise up to object to the establishment of such a depot.

It is here assumed that the procuring of land, while it is difficult, is not impossible.

A few days since, I visited the model farm at Rookwood Station, and found that since my last visit a stupendous amount of work had been done in breaking up ground, trenching, draining, and

planting; the locality is elevated and exposed to the sun and wind, and therefore liable to suffer in summer from the effects of the long dry months.

The whole area is accessible to the waters of the new supply from the Nepean; but that work could not afford water for the irrigation of such an area without reducing the head required for giving an ample supply to the Syney reservoir.

It struck me while viewing the ground, that a large proportion of the sewage of the western suburbs might be utilized here, and would form both an irrigating as well as a fertilizing agent if it could be delivered here.

The site being elevated, it follows that the sewage would not gravitate there; but if it have a value as irrigant and fertilizer, the cost of a line of pipes for its conveyance of a pumping plant, and the labour of pumping would not be very great.

A large tank could be constructed here to receive the sewage at the highest elevation, whence it would command the surrounding land, and contrivances could be designed whereby the sewage could be conducted by night into rumnels opened during the day for its reception.

Lieurnur System.

This system has attracted very considerable attention from the public and authorities of Europe, and for some social conditions, as life in barracks, &c., no doubt, it meets a long felt want.

It proposes to draw the contents of water-closets through iron pipes into reservoirs constructed underground in a convenient spot, by suction, or to speak more scientifically, by exhausting the air in the reservoir.

This scheme has procured high encomiums from Belgian, Russian, and French authorities for adaptability under certain circumstances; but as it only proposes to deal with night-soil, and municipal bodies around Sydney will require a scheme which will dispose of both products, viz., house slops and night-soil, therefore, the Lieurnur system would require to be supplemented and a system of the nature of the one I am advocating, would be necessary in addition to the Lieurnur's system, entailing immense cost, it must suffice to say that it does not meet the requirements of our suburbs, notwithstanding that it discloses in its invention a very commendable amount of ingenuity and thoughtful labour.

I have this afternoon received an advance proof of Mr. Stayton's report to the Sewers Department on the sanitation of North Shore, and I need not perhaps say that, like all modern engineers, he prescribes identically the plans advocated herein for that suburb.

As I have never exchanged one word with Mr. Stayton on this subject, it serves to prove the unanimity of engineers in England.

on the question, that while the system spoken of is not perfect, yet it has so far stood the test of criticism and practice with the best practicable results.

I would much like to have had more time to have thoroughly digested his recommendations, but was not aware before to-day that he was engaged on the work.

I would reiterate here my former statement as to pumping the sewage in its raw state to farms at some distance from town, as pumping is an inexpensive mode of conveyance, and I am convinced that if the experiment named by me of pumping the sewage of the western suburbs to the Experimental Farm at Potts' Hill were tried it would be attended with success.

Reproductiveness of Sewage.

Up to the present time information is conflicting both as to the manurial value of the residium of sewage, and no doubt it varies in different localities. Writers on the question must be read as a whole and not individually, as their writings sometimes assume the view most advantageous to the side they are contending for.

I deem it safe to advise communities to refrain from expecting any great return for their outlay. Some of it they will no doubt get back, but should look to the benefits arising indirectly in the form of improved wholesomeness of their breathing-air as well as to the comfort, convenience, cleanliness, and cheapness, of the accommodation for their return.

The products will be marketable, but the cost of producing them will always reduce the returns.

The adoption of a system of sewers of the character here sketched has uniformly lowered the death rate in communities where it has been introduced.

Ventilation.

I have, in a previous paper read in this room, advanced my opinions on the ventilation of the sewers and the dwelling, and refrain here from doing more than saying that the system then advocated is recommended for adoption in all the suburbs as well the city, and may be briefly described by stating that it consists of intercepting the sewer-gas at the front of a large proportion of lofty houses, and conveying it by pipes to the ridge of the roof, where it will get diluted with the surrounding air.

I would now conclude with the recommendation to local bodies to persevere in effort until they secure their object, which will at once lower the sickness and death-rate; not to require the Government to provide for their wants, but boldly to apply themselves to the work, remembering that if the Government did the work the residents must pay for it in the long run, and remembering also

that a light tax will enable the various local bodies both to meet the interest of a loan and also provide a sinking fund for the final extinction of such loan.

It should also become an accepted principle with local bodies that to be free from debt while permanent, useful, and reproductive works remain unexecuted is a false economy and a vice.

Discussion.

Sir Alfred Roberts desired to know how such a scheme, if adopted by an isolated community, could be made to work in with a general scheme.

Mr. Trevor Jones replied that a general intercepting trunk sewer would traverse the whole of the districts concerned and deliver the whole at a general establishment for treatment; by a district he explained that he did not mean a municipal district, but a drainage district, which included all the land that would drain into the sewer in question, or in other words a valley. If obstructions or difficulties existed then a system of pumping would remove all such difficulties.

Mr. Henson submitted that any general scheme for the Western Suburbs should include some provision for draining the marshy land lying between the heights and the Parramatta River, which, to his personal knowledge, were in a very polluted condition; and he said that he hoped that measures would be taken to prevent building on these marshes after merely filling over the swamp with town rubbish, as is done in some parts.

Mr. Stayton expressed his satisfaction at being present to hear the paper, and stated that he is now retained by Government to report upon the introduction of some such scheme into the suburbs, but could not so early disclose his views not having sufficiently advanced his plans.

MEDICAL SECTION.

Seven meetings of this section were held during the session of 1886, under the presidency of Sir Alfred Roberts.

The average attendance of members was considerably below that for the session of 1885, the average number present having been sixteen, the highest number twenty-two, and the lowest ten. There was no falling off, however, in the amount of useful work done, the average number of papers read at each meeting being three; in addition to which many living subjects, pathological specimens, and models of diseased conditions, were exhibited. The papers attained a high standard of excellence, and were remarkable not only for their practical character but for the keen interest and serious discussion to which, for the most part, they gave rise.

The section had, during this session, to deplore the loss by death of its esteemed member Dr. Walter Fawkes Mackenzie, and the fifth ordinary general meeting was adjourned as a mark of respect for his memory, and of condolence with his widow in her affliction.

J. ASHBURTON THOMPSON, M.D.
A. MacCORMICK, M.D., &c.

LIST OF PUBLICATIONS.

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1886.

Vol. XX.

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Sydney: Charles Potter, Government Printer.—1887.